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ABSTRACT

This guide presents examples of Florida's unique natural environments, its attempts to preserve natural areas, and to perform the careful balancing act required to encourage development for its ever growing transient and permanent resident populations without destroying valuable natural resources. The volume offers a look at some of the less publicized industries of Florida. Using the Central Florida region as a case study, the guide introduces the reader to its physical, population, and economic geography along with the land use characteristics of Florida - replete with both potential problems and prospects. Articles include: (1) "Megalopolis in the Making: Urbanizing Central Florida's I-4 Corridor" (Kevin Archer); (2) "Was There Life before Disney? The Historical Geography of Central Florida" (Ary J. Lamme III); (3) "The Landscapes of Kissimmee and Osceola County" (Ray Oldakowski); (4) "Florida's Population: Looking Back and Ahead" (Ed Fernald); (5) "Transportation and Development in Central Florida: The Rise of Orlando in the Transport Hierarchy" (Russell Ivy; Michelle Falasz; Pedro Palimino); (6) "The High-Tech Economy of Central Florida: Genesis, Character, and Role of the Orlando Area Laser Industry" (Eric Young); (7) "Citrus in Central Florida" (Cesar Caviedes); (8) "Everglades at Risk" (Jon Byron); (9) "Geomorphology of the Rivers of Peninsular Florida" (Joann Mossa); (10) "Coastal Geography of Central Atlantic Florida" (Heidi Lannon; Joann Mossa); and (11) "Sinkholes in Florida" (Robert Brinkmann). Ten lessons written by classroom teachers on the geography of Florida conclude the volume. (EH)

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ED 422 265

Title No. 16

A Pathways in Geography
Resource Publication

National Council for
Geographic Education

Growth, Technology, Planning, and Geographic Education In Central Florida: Images and Encounters

Ray Oldakowski, Laurie Molina,
Betsy Purdum, Editors

Prepared for the 82d meeting of the
National Council for Geographic Education,
Orlando, Florida, October 8-11, 1997

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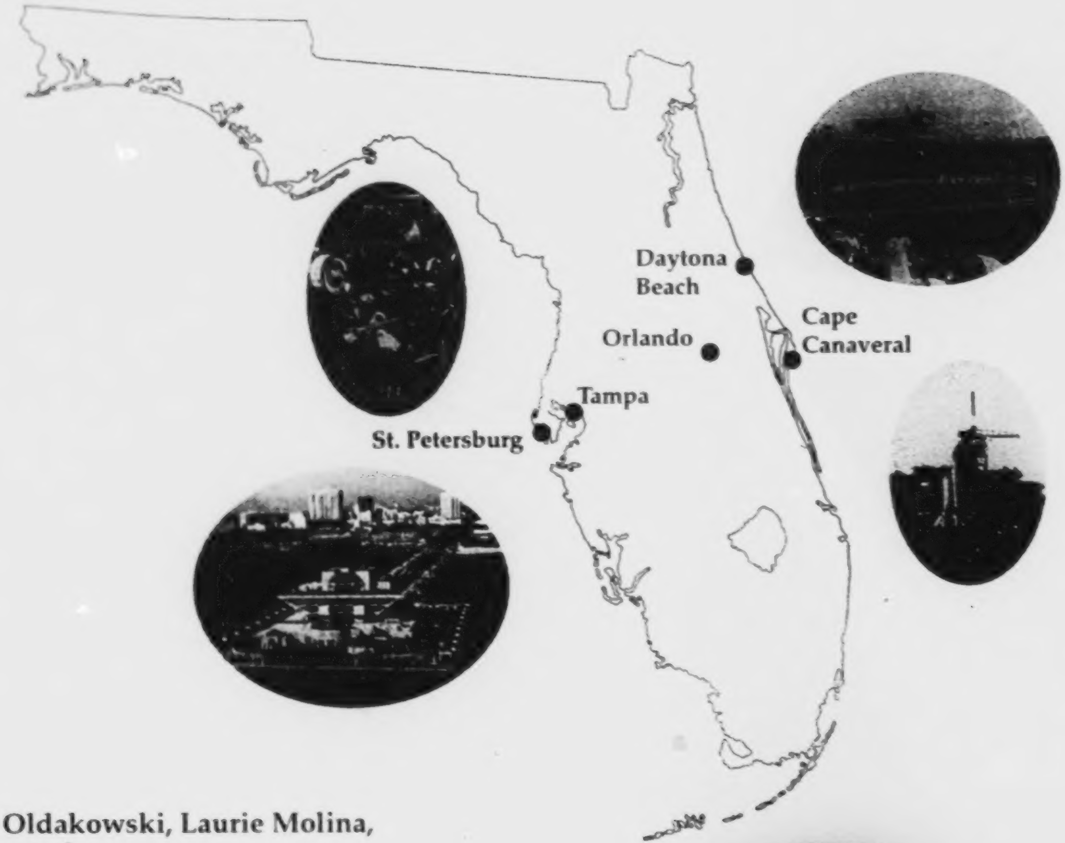

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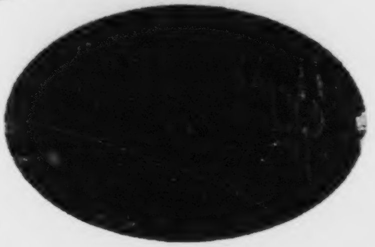

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Growth, Technology, Planning, and Geographic Education in Central Florida: Images and Encounters

Ray Oldakowski, Laurie Molina, Betsy Purdum, Editors

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Welcome to Central Florida!

Welcome to the 1997 Site Guide for the annual meeting of the National Council for Geographic Education! In keeping with the meeting theme, "Growth, Technology, Planning and Geographic Education," we have prepared this site guide to give the reader a feel for why Florida, and especially the Central Florida region, could fulfill a regional or systematic geographer's idea of paradise.

In the following chapters, readers will recognize examples of Florida's unique natural environments, its attempts to preserve natural areas and to perform the careful balancing act required to encourage development for its ever growing transient and permanent resident populations without destroying valuable natural resources. As state and local governments plan for Florida's future, they must consider the well-being of the millions of residents and visitors crossing the border each year. The site guide also touches on systematic topics related to urban growth and technological developments that will affect not only central Florida in the coming years but the nation as a whole.

While giving the reader a sense of Florida's dynamic urban growth, the authors also provide a look at some of the less publicized industries such as phosphate extraction and agriculture and include some discussion of the state's physical geography and the vital water resources necessary for everyone's existence.

The Orlando area and the population centers along the Interstate 4 corridor provide visitors with an ever changing and growing commercial tourist region where more than 3 million tourists visit each year. Although considered one of the premier commercial vacation spots in the United States, many visitors will still find some of the pristine natural springs, forests, and untouched Florida landscapes that served to attract tourists in the past. The subtropical climate and unique flora and fauna of these protected regions were once the focus of tourist brochures that drew thousands of adventurous visitors into this relatively undisturbed region. Nature enthusiasts and others still can enjoy the rural Florida reminiscent of Marjorie Kinnon Rawling's *Cross Creek* without the distractions of commercial tourist areas and city skylines.

Using the Central Florida region as a case study, site guide authors introduce the reader to its physical, population, and economic geography along with the land use characteristics of Florida—replete with both potential problems and prospects. Regardless of one's scholarly interest or specialization, the site guide editors and authors hope to provide those attending the 1997 Annual Meeting of the National Council for Geographic Education with a geographic instrument to assist them in sharing their experience with others. Again, welcome to the Sunshine State and enjoy the meeting!

Laurie Molina, Florida State University

Megalopolis in the Making: Urbanizing Central Florida's I-4 Corridor

1

Kevin Archer

The literature of urban geography has recently devoted much discussion about the rise of new forms of urban life, sometimes dubbed the post-modern or post-industrial turn in city development (Harvey 1989; Knox 1992; Lash and Urry 1994; Soja 1996). This chapter will highlight two main characteristics of this historical turn. First, the built and social environments of cities have spread rapidly over ever wider swaths of territory. The result of this geographic spread is an increasing lack of centrality in contemporary city life leading to what can be called *de-centered urbanism* or, more concretely, the movement from central place cities to swiss-cheese urbanism. Besides the environmental ramifications of such an expansion of the built environment, the social implications of post-industrial urbanism concern the ever increasing isolation of classes and ethnic groups behind literal and metaphorical community *gates* and the resulting ignorance of any common public concerns or civic responsibilities.

The second characteristic of this post-industrial turn is that city development is increasingly based not so much on the real physical or even social characteristics of the place. Rather, city development is now based more on the image of the place struck in the minds of ever more footloose firms and professionals. The fortunes of cities in this post-industrial age rest on how well they can be imagineered (in Disney parlance) as good, clean, safe, even fun places to locate and work. Since post-industrial service firms and professionals can locate just about anywhere, packaging places in this way is absolutely necessary to attract and retain development (Kearns and Philo 1993). Hence, every city must have its own festival marketplace, its own re-done, gentrified docklands or industrial district, its own new stadium, aquarium, arena (pick one), and its own bright new, sanitized image of some local, striking attribute to portray in the increasingly competitive place commodity market.

Now most of this new urban geography literature on the post-modern, post-industrial turn pays attention to world cities like New York, London, and certainly Los Angeles. In this chapter, however, I argue that Orlando is really the quintessential example of this new form of urbanism. Pay attention to what is happening in Orlando now and you will see both the present and the future of post-industrial urbanism. Stay closely tuned; the story of Orlando is only beginning to emerge and, to date, has been only slightly told; perhaps, then, you can join in the telling after your brief stay here.

Fitting ORLANDO into the Post-Industrial Storyline

Orlando is the rapidly emerging place to be, and to be seen, in the late twentieth century. Not so much in terms of Hollywood style glamour—although that, too, is evolving as both Disney and Universal Studios expand their movie theme parks. Rather, Metro Orlando is emerging as the quintessential post-industrial urban locality to which most other cities in the world aspire to be, in their own way. It is an urban area that footloose post-industrial firms and people find appealing; much more appealing than other areas with longer histories of industrialization, class and racial tensions, and deteriorating infrastructures. No matter how many cities attempt to re-make their docklands or industrial wastelands into tourist attractions and boutique malls, Orlando will continue to be at the forefront of the competition for business and professional relocations. For this reason, Metro Orlando should be considered the capital of the twenty-first century.

This is not the only reason. Another can be found in the specific physical and social substance of the place; or, rather, *places* of Orlando. The physical and social morphology of Metro Orlando is almost completely made-over in the image of our footloose social economy. There is no real *center* to the Metro area. Instead, a collage of urbanized bits hang loosely together by a series of highways and interstates. As described in detail elsewhere, Metro Orlando is a prime example of what Sorkin (1992: xi, xiii) calls the late-twentieth century "a geographical city" consisting of little more than a "swarm" of such urban bits without a central place (Archer 1997). In more ways than the over-written case of Los Angeles, Metro Orlando is nothing if not a picture of our urban future.

I begin this piece on the urban social geography of Central Florida with Orlando for an even better reason than simply that you will be located here for a brief stay. Historically, it probably would make more sense to start with Tampa, with its colorful beginning as a west coast tourist attraction and later cigar manufacturing center. Typically, it probably would make more sense to begin the narrative with an account of the citrus and phosphate industries arising with the coming of the railroads to metro Lakeland-Winterhaven. Some account of all of this will be forthcoming below. All you need to do is look around you, where you are now, to see that what is happening in Metro Orlando is what is going to determine the urban future of Central Florida as a whole. It is not just the hustle and bustle of too many over-colorful people going the wrong direction on too few streets with too many cars attempting to negotiate their way past too many overdone signs of overly outrageous design. It is rather the way in which historic Orlando has been quite overwhelmed by what can be called the Disneyesque. Indeed, if current trends continue, as they surely will, it is this Disneyesque urban development pattern that will dominate the physical and social motifs of the emerging megalopolis of the Interstate-4 (I-4) corridor from coast-to-coast through Central Florida.

Recovering Pre-Disney Orlando

Orlando, of course, has not always been the ORLANDO that you see around you today. Before the arrival of Disney in the late 1960s, what took place within the city limits was very much like that which took place in any other small Southern cross-roads town. Orlando's social economy was agrarian and transportation based, the latter making it a relative hub of activity in the commercialization of the area's main crop, citrus. The term most people used to describe the pre-Disney city was sleepy, in which change to traditional social and economic relations came only slowly. Although some retirees from the north settled in the area, most of the population worked in agriculture or transportation related activities, including a healthy population of African-American farm workers who settled either in west Orlando City (once known popularly as the city's Black Zone) or in nearby segregated communities like Eatonville, now famous as the original home of Zora Neal Hurston (Argett, Jr. 1991). As late as the 1970s, the number of elite movers and shakers of Orlando's development probably could be counted on one hand. Indeed, one recent account of the period has narrowed it down to just two prominent businessmen, *Orlando Sentinel* owner Martin Andersen and top banker Billy Dial, who apparently conceived, managed, and oversaw all phases of what urban development did take place (White 1995).

Citrus was the overwhelmingly dominant crop in the pre-Disney Orlando area and remains the most important agricultural staple today. The combined production of the five County area of Brevard, Lake, Orange, Osceola, and Seminole, for example, accounted for as much as 31 percent of the total production of citrus in Florida as late as 1971 (measured in boxes, Malecki 1996; see Figure 1.1 and Caviedes's Chapter 7 in this volume). Railways, and eventually intra- and inter-state roads and highways, converged in Orlando to complete the distribution of the crop to markets. Indeed, one of the reasons Walt Disney decided to locate his eastern theme park in the area is that it had a well articulated transportation network resulting in ease of access from all points on the east coast of the United States (Bryman 1995).

Changes were taking place in the immediate environs of the traditional city limits that somewhat belies this rather bucolic picture of Orlando's pre-Disney past. During World War II, three major military bases—Pinecastle to the south, Orlando Air Base more centrally located, and Sanford Naval Air Station to the northeast—opened in the area, bringing significant numbers of people to the area, many of whom eventually settled. Of particular importance, those who came to the area for this reason were educated and highly skilled in aviation technology and engineering. In addition, by 1950, the first missile launch from the nearby Cape Canaveral complex was to take place. According to Keuchel (1990), between 1950 and 1960, more than $400 million was spent developing the Cape and the space missile complex employed as many as 17,000 people. Private aerospace and associated firms like RCA, Honeywell, Sperry, and Martin (now Lockheed Martin) also eventually located in the area resulting in the growth of urbanized bits such as Cocoa, Cocoa Beach, Melbourne, and Titusville in Brevard County along what is still called *Florida's Space Coast*.

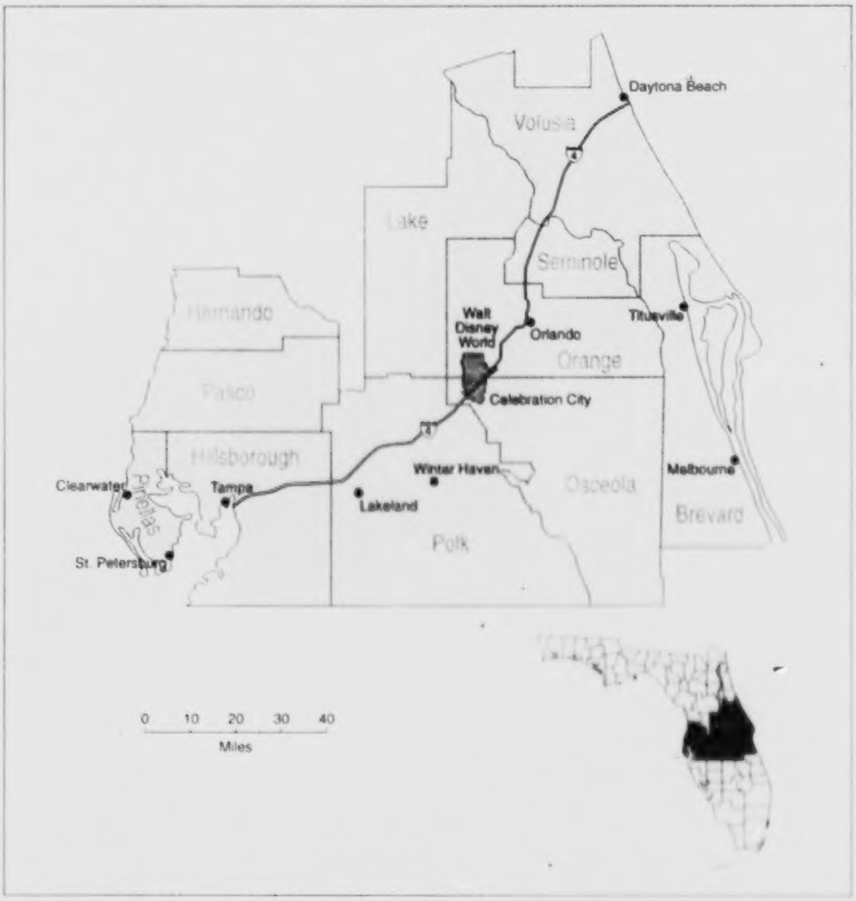

Figure 1.1: Central Florida's I-4 Urban Corridor

These pre-Disney developments need to be emphasized for three reasons. First, because of the massive onslaught of Disneyfication, this significant high-tech component of the greater metro area's economy is given very short shrift in most accounts of *the tourist capital of the world*. The Martin Company opened a major facility as early as 1957 just four miles south of Orlando's downtown area. By 1961, this facility employed over 10,000 people many of whom found residences in the direct vicinity (Bacon 1972). Today, such high-tech and related activities remain a significant component of the local economy as firms like Harris, Martin, Lockheed, ITT Corporation, AT&T, and McDonnell Douglas employ close to 50,000 people in Orlando and Space Coast facilities (*Orlando Sentinel* May 18, 1992).

The second reason that this significant high-tech component of the local economy needs to be emphasized is that it well portrays the intimate economic linkages between Orlando and the Space Coast, including Volusia and Brevard Counties. A good number of those who originally came to work on the Space Coast found homes somewhere between Orlando and their place of work. At the time, Orlando was considered to be the closest "big city," with the kinds of social, economic, and cultural attractions still missing in the then very small settlements on the coast. Living somewhere in-between the coast and Orlando allowed many to enjoy the attractions of a mid-sized city (88,000 inhabitants within the city limits in 1960; see Table 1. 1) and still be within commuting distance to their work. Indeed, although the cities of Melbourne,

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Titusville, and Palm Bay now are included in their own Metropolitan Area, the development of these cities has always been related to that of Orlando in this way. Now, of course, this relation is even more manifest as these urban places come into ever closer proximity to the spread of present-day, post-Disney ORLANDO.

Table 1.1: Total Population: Selected Central Florida Counties and Cities
(counties are in boldface type)

	1960	1970	1980	1990	1992
Florida	**4,952**	**6,791**	**9,746**	**12,938**	**13,424**
Brevard	**111**	**230**	**273**	**399**	**418**
Cocoa	12	16	16	18	18
Melbourne	12	40	47	60	62
Hillsborough	**398**	**490**	**647**	**834**	**854**
Tampa	275	278	272	280	282
Plant City	16	15	19	23	24
Lake	**57**	**69**	**105**	**152**	**163**
Eustis	6	7	9	13	14
Leesburg	11	12	13	15	15
Orange	**264**	**344**	**471**	**677**	**713**
Apopka	4	4	6	14	15
Orlando	88	99	128	165	170
Osceola	**19**	**25**	**49**	**108**	**120**
Kissimmee	7	7	15	30	31
St. Cloud	4	5	8	12	14
Pinellas	**375**	**522**	**729**	**852**	**861**
Clearwater	35	52	85	99	100
St. Petersburg	181	216	239	239	239
Polk	**195**	**228**	**322**	**405**	**421**
Lakeland	41	43	47	71	72
Seminole	**55**	**84**	**180**	**288**	**306**
Altamonte Springs	1	4	21	35	36
Winter Springs	nd	1	10	22	23

Source: *Florida Statistical Abstract*, various years.

The third reason for emphasizing these early developments is closely related to this second. The arrival of military and aerospace related activities certainly brought numbers of people to the Orlando area in the 1940s, 50s, and 60s. Most importantly, those who stayed settled largely in areas outside the traditional city limits, close to the new military bases or toward the Space Coast. Even before the main effects of the arrival of Disney were being felt in the 1970s, the Orlando area was evolving into a mosaic of suburban and exurban bits surrounding the traditional city, particularly toward the northeast and the southeast. Although the Disneyfication of Orlando certainly accelerated this trend—particularly to the northeast and southwest of the traditional city limits—the metropolitan area already was beginning to exhibit a decentered nature.

Orlando becomes ORLANDO

Walt Disney learned many lessons from his experience of building his first theme park in Anaheim, California. Of most importance for the future of Central Florida, one of these lessons was the perceived need to control as much of the territory around his theme park as possible in order to avoid imitators of a different, less Disney, ethos. In the search for the right location for his Eastern theme park in the early 1960s, Walt thus hoped to find a place where much property could be had for the right price and with few outside, regulatory hindrances. The Orlando area ultimately proved ideal, in this regard, as a wide-open, yet accessible, territory with little government oversight other than the traditional overwrought boosterism any small town seeks to spur economic development. The proximity to all the futurism and patriotism associated with the rapidly expanding space program on the coast, made the location doubly ideal for Walt's purposes (Fjellman 1992; Mosley 1985).

Through the use of dummy land-development brokers, Walt's company was able to buy—secretly, to avoid speculation—about 43 square miles (27,400 acres or 10,938 ha) of territory some 20 miles (32 km) southwest of Orlando's traditional center. Afraid of losing Disney jobs to another state, the Florida legislature passed a series of laws in 1967 that provided Disney with its own governmental unit, the Reedy Creek Improvement District, covering the vast territory acquired. Of importance here, this privatized governmental structure is not only novel, even for the United States, but also set the tone for the Disney Company's future dealings with other governmental units in the area. As a result of the powers accorded to it, Reedy Creek is, according to one prominent politician of the time of enactment, "10 times more powerful than any other local government in Florida" (cited in Anderson 1991).

In any case, Walt's original plan was to build another Magic Kingdom in order to make enough profit to undertake the development of his new idea for a "city of the future." He did oversee the construction of the new Kingdom, significantly located well within the territory he acquired in order to control the periphery. Walt died, however, before his favored project for an Experimental Prototype Community of Tomorrow (EPCOT) had left the drawing board. After Walt's death, the plans for EPCOT were severely scaled back from a planned residential community of the future to the mere theme park that you see today. Yet, Walt's dream town idea remains important for the present narrative because the new Disney Company of Michael Eisner actually has begun to act on it in the form of a massive undertaking now being built on de-annexed Disney territory in northwestern Osceola County. This new town, Celebration, will eventually have as many as 20,000 fiber-optically linked residents, its own business and retail center, schools, and a hospital—all built in the spirit of Walt's original EPCOT idea.

Everyone reading this piece must tour this new development to get a sense of the magnitude of Disney's Celebration project at the intersection of I-4 and US 192. It is being touted as a prime example of the next generation of gated urban communities, if not perhaps the saving future of our cities (see Archer 1996; 1997). Here, however, the wider urban context of this development must be emphasized. With the arrival of Disney, Orlando became the ORLANDO that you see now almost overnight. The new Disney developments began to pull businesses and residents toward the southwestern Disney site; again, some 20 miles away from the traditional city center. The already suburban and even exurban nature of the metro area was thus stretched in a new direction, while the many new residents riding the coat-tails of the Disney boom also expanded already existing suburban bits to the northeast, in Seminole County, and to the south and west, in Orange and Osceola Counties. This continuing suburbanization of ORLANDO is well illustrated by the data portrayed in Table 1. 1. Between 1970 and 1992, Florida's population grew by 98 percent, largely because of out-of-state immigration. Over the same period, the population of Orlando City grew by only 72 percent. The population of Orange County, however, grew a respectable 107 percent and Seminole County grew by as much as 244 percent, with formerly rural areas replaced increasingly with bedroom suburbs like Winter Springs, Altamonte Springs, and Oviedo (see Figure 1.2). Similarly, the traditionally cattle and citrus-based population of Osceola County grew by as much as 380 percent and that of even more rural Lake County (included in the MSA in 1992) by 136 percent. By contrast, the population of Brevard County grew by only 82 percent and that of Polk County by 85 percent.

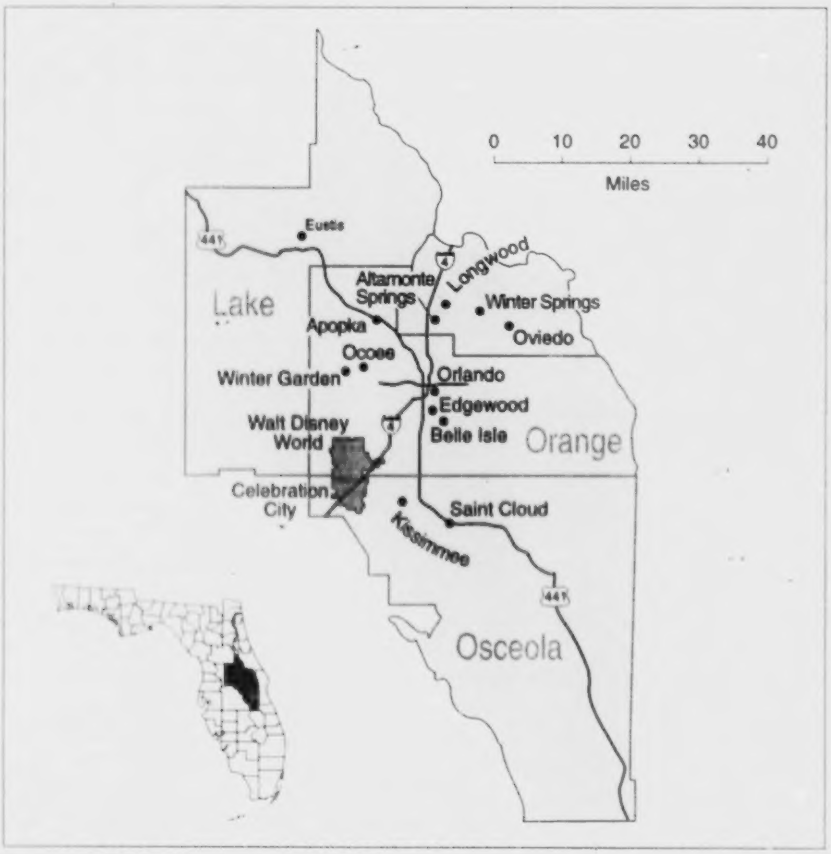

Figure 1.2: The Orlando Metropolitan Statistical Area

Table 1.2: Population Density, 1981-1992

	Land Area in Sq. Miles	Persons per Sq. Mile		Percent Change
		1981	1992	
Florida	**54,157**	**187**	**248**	**33**
Brevard	995	278	420	51
Hillsborough	1,053	637	811	27
Lake	954	112	170	52
Orange	910	529	783	48
Osceola	1,350	42	89	112
Pinellas	280	2,805	3,074	10
Polk	1,823	178	231	30
Seminole	298	613	1,026	67

Source: *Florida County Comparisons*, various years.

Table 1.3: Growth in the Labor Force, 1976-1992

	1976	1992	Percent Change
Florida	**3,604,000**	**6,553,000**	**82**
Brevard	94,640	200,908	112
Hillsborough	276,827	476,583	72
Lake	30,788	59,888	95
Orange	197,770	415,403	110
Osceola	15,714	55,544	253
Pinellas	232,950	420,352	80
Polk	118,913	185,429	56
Seminole	67,675	182,271	169

Source: *Florida County Comparisons*, various years.

In Table 1. 2 you can find another indication of the booming and continually suburbanizing population of post-Disney ORLANDO in the data. Compared to Florida as a whole, the counties of the metro area have become much more densely populated, even over the last decade. Indeed, as one journalist has recently put it, a relative "population explosion" is now taking place in west Orange County, in places like Ocoee and Winter Springs (Quintana 1996). Similarly, the population of Kissimmee, in Osceola County, grew by as much 343 percent and that of its sister, St. Cloud, by as much as 225 percent between 1970 and 1992. With the new Disney development of Celebration, this growth in the population of traditionally rural Osceola, and now Lake Counties will only continue apace.

The Disneyfied City

The Disney image thus has attracted many people to ORLANDO to stay. This is true also of many businesses, increasingly footloose in our post-industrial economy. It is not just the mild climate of the area, it is also the belief that ORLANDO is as new, clean, sanitized, and safe as a Disney theme park. Furthermore, many tourist-related firms have opened in the area in order to accrue agglomeration economies deriving quite directly from Disney's presence in the area. Not surprisingly, this rapidly expanding economic base is reflected in the labor force data portrayed in Table 1. 3. I argue in detail elsewhere, however, that some real social issues are emerging that relate to this boom in the area's economy (Archer 1997). Briefly, the local labor market appears to be bifurcating between few high-paid, high-skilled jobs and much lower-paid, low-skilled tourist-related activities that make up the vast majority of the new jobs created. The importance of this trend in the labor market for the present purposes is that it has become manifest in the importance of this trend in the labor market for the present purposes is that it has become manifest in the housing market, with the increasing lack of affordable housing being the most crucial public policy problem.

One of the main reasons that ORLANDO continues to spread so rapidly, for example, is that many newcomers search for affordable housing in the more rural parts of the metro area. Although Seminole County continues to be built out by more affluent, higher-skilled, newcomers, the voracious search for affordable housing is pulling the urbanized area increasingly to the south and west, now including Lake County and northeastern Polk County. Indeed, largely because of Disneyfied ORLANDO's pull on the more rural parts of the neighboring metropolitan area of Lakeland-Winter Haven, suburb-to-outside MSA commutes (that is, largely from this MSA to the Orlando MSA) increased from 5 percent to over 9 percent between 1980 and 1990 (CUTR 1994). This is a trend that will only accelerate as new Disneyesque tourist developments continue to appear in Osceola and Lake Counties.

Squeezing Tradition: Lakeland/Winter Haven in the Middle

In addition to the voracious demand for more rural, more affordable housing, another major factor has accelerated the urbanization of Central Florida: the rapid decline of citrus production. Central Florida, once the major producing area of the State, has experienced an enormous restructuring of the citrus industry. The result of this restructuring is that many former citrus farmers, particularly in Brevard, Orange, and Osceola Counties, have put former productive land up for sale to real estate developers. The cause of this restructuring is twofold. First, firms in the frozen juice business have consolidated rapidly (most Florida citrus is grown for this market) in which major firms, as a direct result of increasing global competition and recently enhanced by the North American Free Trade Agreement (NAFTA), have bought many smaller family farms. Second, a series of severe freezes occurred throughout the 1980s that killed many of the producing trees in the area, with the result that many farmers faced substantial losses in the industry (Burns 1993). Because of these factors, Florida citrus production has generally moved southward toward the Everglades. Citrus production is increasingly made up of large agribusinesses operating large-scale plantations.

Polk County, however, has successfully maintained much of its citrus production and remains the leading citrus producing county in Florida. Referring back to Tables 1. 1, 1. 2, and 1. 3, neither Polk's population nor its labor force has experienced substantial growth over the last three decades. The cities of Lakeland and Winter Haven continue to cater to agricultural distribution and commercialization and, until very recently, have continued to exist largely according to the cycles of citrus production. Lakeland derives its name from the many lakes surrounding it, some of the 600 or so lakes that dot Polk County as a whole. Lakeland is also home to Florida Southern College, which urban geographers should know for its many buildings designed by the famed architect, Frank Lloyd Wright. Another tourist attraction, Bok Towers, near Lake Wales, is also of interest to urbanists because the grounds were designed by Frederick Law Olmstead, famed for his design of Central Park in New York City.

The other major industry of Polk County simply accentuates the rural, rather traditional nature of the area. Beginning as early as the 1880s, phosphate has been mined commercially in southeastern Polk and southwestern Hillsborough Counties. Phosphate production is not only a mainstay of the Polk economy it is also an industry that links the Lakeland-Winter Haven Metropolitan Area directly to that of Tampa-St. Petersburg-Clearwater. As I will note later, Tampa's port is heavily industrial and overwhelmingly dominated by two commodities, petroleum and phosphate, much of the latter being exported from Polk County sources. In any case, southwestern Polk County is literally dotted with in-service and out-of-service phosphate mines and their various slag heaps and built structures surrounding communities like Mulbury and Brewster.

The running theme of this narrative, however, is that this traditional, rural character of the Lakeland-Winter Haven Metropolitan Area is destined to change quite dramatically in the near future. Indeed, an excursion south along I-4 from Orlando through Lakeland to Tampa tends only to corroborate this assertion. What is happening along the I-4 corridor will thoroughly change the profit-loss calculus of many a landowner, even currently successful farmers. Already mentioned is the southwestern spread of Disneyfied

ORLANDO, which is now affecting—and will affect even more as Celebration comes on line—northwestern Polk County in the form of tourist-related businesses and sprouting subdivisions. Also, an increasing spread will recur toward the east from metro Tampa, as more and more firms and people suburbanize along I-4, currently being significantly widened to accommodate the increased usage. The pull of suburbia and the promise of the markets associated with Disneytopia, have made the I-4 corridor one of the most promising business and residential locations in the state. Although Polk County south of the corridor is likely to remain bucolic—even with some concern now over the depletion of phosphate mines and the southward movement of this industry into Hardee and Manatee Counties (Scott and Cathcart 1996)—Polk County bordering the corridor is now being squeezed by these pincer spatial trends of post-industrial Disneyesque development.

Imagineering the Past: Tampa Bay in Flux

The Tampa/St. Petersburg/Clearwater Metropolitan Area is the last case to be considered in this rather rapid tour of the urban social geography of Central Florida (Figure 1.3). The story of Tampa is particularly intriguing as the city was industrial—instead of agrarian or tourist-related like all other southern Florida cities—from its beginning. The other two cities in the metro area, St. Petersburg and Clearwater in Pinellas County, are much closer to the characteristics of the popular conception of sunny Florida. Given their close proximity to Gulf of Mexico beaches, both of these cities developed largely on the basis of tourism, particularly for the elderly. As indicated in Tables 1. 1 and 1. 2, the population of Pinellas County has grown considerably over the last decades mostly in cadence with our overall aging population. The limited land area of the County also, of course, has resulted in an extremely high density of population.

Today's Pinellas County, however, is not only a reflection of its beach orientation. The metro economy of the area is now noted for its many high-tech medical and defense related industrial and post-industrial firms, employing a growing number of newly relocated, highly educated professionals. This influx of professionals is not only changing the demographic profile of the county it also has brought significant socio-spatial changes. Many new suburbanized bits of residential and business developments—like Largo and Pinellas Park—have sprouted up between St. Petersburg and Clearwater, so much so, that the ending of one city and the beginning of the other is blurred as the built environment has marched rapidly north up the coast. Downtowns, particularly that of St. Petersburg, also have become gentrified in the image of the new professionals.

Yet, the rapidity of this gentrification of the county has left a certain unevenness to the social consistency of the urban area that refuses to be smoothed. Indeed, this unevenness can be considered the major difference between the post-industrial make-over of Tampa Bay as a whole and that of Orlando. Orlando's pre-Disney past has largely been smothered by the post-Disneyesque. Because of the lack of an overwhelmingly hegemonic theme—and deep pockets—like that of Disney, however, the socio-spatial past of the Tampa Bay region continues to coexist with the increasingly post-industrial present and likely future. Put differently, although Orlando has been completely imagineered in the image of the Disneyesque, only some bits of Tampa Bay have been, and these exist in a strange juxtaposition with other bits that continue to exhibit all the socio-spatial characteristics of industrialism and elder-tourism. In Pinellas County, this strange juxtaposition is mostly that of lower-middle-class trailer parks mixed with suburban developments for the wealthy and urbane. It also can be found in the central cities, again, particularly in St. Petersburg with its longer, more diverse history.

In its 1931 charter, for example, the civic leaders of St. Petersburg set the goal of accomplishing "separate residential limits or districts for white and Negro residents" (Arsenault 1988, 265). This early African-American population found employment as servants and as stevedores on the industrial docks on both sides of Tampa Bay. Hovering around 20 percent of the population of the city today, the progeny of this original Black population remain quite centralized in poverty-stricken inner-city areas literally surrounded by many new urban developments—the relatively new domed stadium, the refurbished public pier, and many nightclubs, hotels, and restaurants—catering mostly to the local gentry and tourists. This is, indeed, an extremely volatile socio-spatial juxtaposition of difference that has led—most recently during last year's presidential election—to flare-ups and even riots involving inner-city folk forcefully voicing their concerns about their plight in the redevelopment of their city.

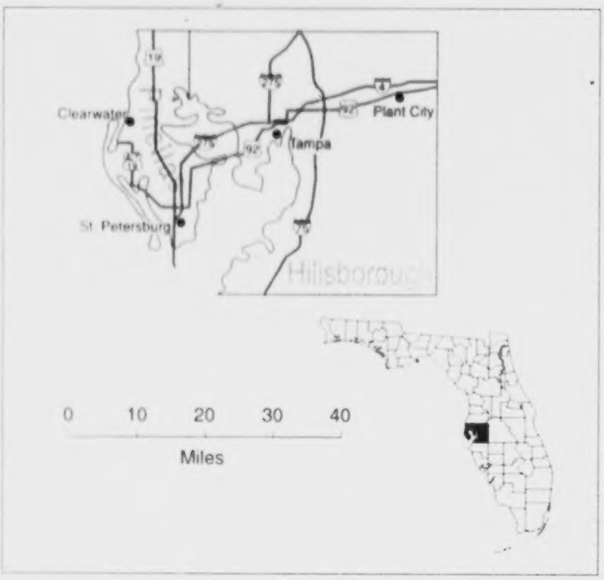

Figure 1.3: Tampa-St. Petersburg-Clearwater Metropolitan Statistical Area

This unevenness in the post-industrial imagineering of the Tampa Bay metro area is the main reason that ORLANDO will continue to grow and prosper at an increasingly faster rate. Somehow homogenizing the quite different African-American and working class local histories into a common, Disneyesque theme that would be attractive to post-industrial firms and professionals has proven difficult. Similarly, razing the built environment in this gentrification process necessarily affects people's habitats in Tampa Bay in ways wholly absent in the development of relative greenfield sites in Orange, Osceola, and Lake Counties. Most importantly, although the forced spatial separation of the races was historically common practice all over the urban South, the Tampa Bay African-American community evolved in a rather unique context that rendered it central to local urban life as a whole. Unlike in the seasonally-oriented, agrarian Orlando area, African-Americans in Tampa Bay worked year-round in industrial and port-related jobs. Their history is fused indelibly with that of the entire industrial working class of the metro area. Their history, in other words, is not separate nor, indeed, separable from that of most of Tampa Bay's traditional White residents.

This last point provides the necessary segue to the analysis of the City of Tampa, the largest in the metropolitan area. Unlike other cities in Central Florida—indeed, unlike all other cities in southern Florida as a whole—Tampa emerged as a city built on industry, not agriculture. One of the early speculators on Florida's future, Henry Plant, brought the railroad to Tampa and built the lavish, Moorish-ornate, $3 million dollar Tampa Bay Hotel in the late 1880s hoping to make Tampa a new tourist destination for the Eastern elite (this hotel, with its elaborate architecture and sprightly turrets, is now home to the University of Tampa and is a must-tour for urbanists). Plant never could make a success of tourism on Tampa's side of the bay. Instead, Tampa's growth became tied to the decision of two expatriate Cubans, Vincente Martinez Ybor and Ignacio Haya, to relocate their cigar factories from Key West to about two miles northeast of Tampa. By 1886, they had accumulated more than 111 acres (45.3 ha) of land where they eventually created a cigar factory town, soon to be known as Ybor City. Attracted by the success of Ybor City, another financier, Hugh Campbell MacFarlane, purchased several hundred acres north and west of Tampa to create another cigar manufacturing town, later to become known simply as West Tampa (Mormino and Pozzetta 1987; Abresch 1996).

All that is left of this industrial beginning to Tampa are the few remnants of architecture left over after the community-devastating urban renewal and highway development projects of the 1950s and 1960s. The Ybor City district of Tampa continues to attract tourists for a view of the area's Hispanic heritage. The heritage of Ybor City has become one of the themes that Tampa's power structure hopes to capitalize on in the post-industrial redevelopment of the city. Here, however, the emphasis is on the industrial nature of Tampa as well as on the colorful nature of the city's early working class, as most cigar workers were immigrants from Latin America or southern Europe, bringing with them the socio-cultural traits of their various homelands.

The other major economic engine of Tampa's growth was, and continues to be, its port. As already mentioned, of particular significance to the growth of activities at the port was the discovery and recovery of phosphate from mines in eastern Hillsborough and Polk Counties. Today, Tampa's port remains heavily industrial, with as much as 98 percent of the tonnage passing through it characterized as bulk cargo (Port of Tampa 1995). Phosphate continues to be the main export and petroleum has become the overwhelmingly dominant import. Because of its relative inaccessibility to networks of transportation to larger east coast markets, the Port of Tampa largely has missed the trend toward containerization and is largely uncompetitive with major ports on Florida's east coast, like Jacksonville and Miami. Also, until very recently, Tampa has been effectively by-passed as a potential home-port for the increasingly popular and lucrative cruise ship industry.

This last point brings the narrative closer to home. Of particular interest, the port was virtually the only place historically where African-Americans could find a job with somewhat decent wages. The local longshoreman's union, for example, still acts as a springboard for African-Americans into local politics. Now constituting more than 20 percent of Tampa's population, the African-American community remains located in districts around the port and in traditional inner-city neighborhoods like Ybor City, West Tampa, and Tampa Heights. Of most importance, the history of this community is linked quite intimately to that of the port and industrial docklands—precisely one of the districts that the city is now attempting to re-construct along more Disneyesque, post-industrial lines. This is a major reason why the African-American community fought so vehemently against recent plans to construct a pirate-ship museum as one of the cornerstones of Tampa's waterfront redevelopment scheme. Because the pirate ship to be featured was found to have once served as a slave ship, the African-American community felt the proposed museum, which was to feature a fanciful full-scale model of the ship sinking in high seas, represented a double insult, both to their race and to their local history. After much protest, the plans for the pirate ship museum were finally dropped and a large hole was left in the plans to imagineer the docklands from Ybor City to the downtown area (Archer 1996).

Again, such deep-seated social obstacles to the imagineering of Tampa as a post-industrial attraction are what continue to render the city less competitive in the place commodity market. With little social resistance to even the most grandiose development schemes like Celebration, metro ORLANDO will continue to be the place to locate for post-industrial firms and professionals. A tour of Tampa's docklands and downtown area will attest to the fits and starts involved in the attempted re-development of the city. Most recently, the $100 million Florida Aquarium has opened in the docklands and a more than $100 million new hockey arena, the Ice Palace, has opened in the downtown area. A relatively large-scale convention center also opened in the downtown area earlier in the decade, although the city still awaits an appropriately scaled convention center hotel that would make the venue viable. Also of interest downtown are the state-of-the-art performing arts center and public art museum. In other words, Tampa has added most of the ingredients other formerly industrial cities have developed in the pursuit of a post-industrial renaissance.

As the ground truth of any tour of Tampa will attest, many holes remain in this new built and social environment of the city; holes that city authorities are finding difficult to fill. The gentrification of Ybor

City, for example, remains an unfulfilled promise, largely because of the lack of housing left after urban renewal and highway construction. The public housing complex put up as a result of urban renewal, lies just off the main business strip and seems quite out-of-place, both socially and materially, in any redevelopment of the area. Similarly, the new, quite striking, Florida Aquarium has all the characteristics of a cutting-edge facility, both for its architecture and featured attractions. Yet, with no other attractions in real proximity to it, the aquarium sits as a relative island of the Disneyesque in a sea of heavy industrial port facilities, the latter less than aesthetically pleasing and little open to pedestrian consumer demands. Finally, without a conference center hotel, the downtown area remains only second-best on that circuit.

Not surprisingly, then, most of the new professional immigrants to Tampa over the last three decades have located themselves in suburbs like New Tampa to the northeast around the University of South Florida, unincorporated Brandon to the east along highway 60, as well as along the I-4 corridor east toward Lakeland. This has left the downtown and dockland areas virtually deserted after working hours, as suburban professionals increasingly frequent rapidly sprouting suburban establishments, like continually expanding Busch Gardens near the university and the enormous new regional mall complex in Brandon.

In the end, Tampa's attempt to redevelop along Disneyesque, post-industrial lines remains quite uneven, even more uneven than that of St. Petersburg. The lingering perception of the place is that it is a working class, rather unkempt, and still quite unattractive town not yet recovered from hard industrial times. Periodic flare-ups of racial tension, ranging from the more benign protests over community benefits accruing from the Super Bowl and the overall pirate museum fiasco to the more volatile riots and neighborhood looting simply corroborate this perception. As already noted, there simply is no source available to provide the kind of overwhelming counter-narrative imagineering to this reality-based perception of Tampa in the same way Disney was available to the much less complex social past of Orlando. As a result, Disneyesque development in the Tampa area has taken place largely in the northern and eastern suburbs and exurbs on the same sorts of greenfield social and material sites that constitute greater ORLANDO.

The Future Up and Down the Pike

It is not as if Tampa's power structure is not trying to change this reality-based perception of the place. Much local enthusiasm abounds, for example, for the new Ice Palace, the new Tampa Yankee's stadium complex adjacent to the brand new Tampa Bay Buccaneers football stadium, the recent expansion of the Busch Gardens theme park, and the continuing promise of the development of an appropriately-sized convention center hotel. Rather, the problem is that, in these post-industrial times where firms and people are increasingly footloose, *image* is increasingly of most importance in location decisions. Here, hands-down, fully Disneyesque ORLANDO is the clear leader. The Tampa Bay area, no matter how much of its built environment is reconstructed and re-themed, simply will never be considered as clean, safe, socially sanitized, and even aesthetically pleasing as its neighbor to the northeast.

The reason is that the Tampa Bay area has a much more diverse history than the Orlando region, the remnants of which are much more difficult to imagineer into something different, more appropriate for contemporary locational demands, both real and perceived. This is the point at which the present narrative comes full circle. Metro ORLANDO certainly meets, and will continue to meet, these post-industrial demands much better than almost any other city on the eve of the twenty-first century. ORLANDO is a model case in this respect. In a very real sense, ORLANDO is not a city in any of the usual ways that we understand this term. Instead, ORLANDO is simply a de-centered mosaic of urbanized bits continually spreading through the wide swath of territory along the I-4 corridor. In this sense, ORLANDO is merely a metaphor for the entire megalopolis now in the making, from east-to-west and from west-to-east, in Central Florida.

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2

Was There Life before Disney? The Historical Geography of Central Florida

Ary J. Lamme III

Although Florida is touted as home of the *first and last frontiers*, historical geographers have found the Sunshine State to be a challenging research locale. That first frontier, represented by the Spanish in sixteenth century Florida, does not get much attention (Hornbeck 1990). Some have suggested that this is because initial settlement of most of the east coast of North America, unlike Florida, is associated with the English colonies. Material artifacts of Spanish settlement, particularly those from the sixteenth and seventeenth centuries, are few and far between. Floridians also have had difficulty agreeing on an historic preservation plan for St. Augustine, the focal point of Spanish settlement on the peninsula (Lamme 1992). Then too, relatively little support has been available for research into Spanish heritage in Florida from the large South Florida Hispano community of Dade County and environs. It is possible and most certainly desirable that the first frontier get more attention in the future.

Between the first and last frontiers, from the sixteenth to middle twentieth centuries, much was happening in Florida. That period, however, remains relatively untapped by historical geographers as well. Florida was very sparsely populated until the twentieth century, a land on the margins of the nation. The first half of the twentieth century, when Florida really developed, has often seemed too recent for historical geographic analysis.

The last frontier, space, has gotten so much publicity in Florida that anything happening before has seemed relatively inconsequential. Establishment of the *space coast* along the central Florida Atlantic shore, followed by recreational facility proliferation around Orlando, and growth of the entire Tampa metropolitan area compound the impression of modernity in that east-west corridor. Unless one looks hard, it would be easy to get the impression that little went on in Central Florida before Disney and the middle of the twentieth century.

That is not the case. If we take a look at what is going on in the field of historical geography as a whole, some ideas emerge that suggest profitable topics focused on pre-Disney Florida. For instance, a seminal article on directions in historical geography proposed a three pronged approach to analysis of any region (Prince 1971). These three fall under the headings of real, imagined, and abstract worlds of the past.

The real world of the past has also been called the reconstruction tradition in historical geography. In such work geographers attempt to reconstruct the geography of the past, to learn as much as possible about the spatial patterns of a certain place at a particular time. Examining such patterns forms the basis of all geographical study, the arrangement of things along the surface of the earth from physical objects like land forms and water bodies to human objects like people and their activities and work. None of these objects is uniformly spaced on the surface of the earth. Geographers try to determine those patterns, and then explain how they were created. Historical geographers do this work for a past period. In the case of Florida, historical geographers have a gold mine of a place. All those long periods of occupation by different European powers were followed by assertion of American sovereignty. Florida has gone from being a marginal place on the border of empires, to a place of pivotal national importance. We have much to learn about the past geography of the peninsula, as well as about its central regions.

When it comes to imagined worlds of the past, we are discussing Florida's geographical forte. This refers to the image a particular place has in the minds of people near and far. People act and react on the basis of image because our thinking determines our experience. Florida's image has shifted from that of an insect-infested and aboriginal-populated swamp, to a potential plantation agricultural area, to a backwater of the old South, to American River, and today to the bulwark of the new South. Florida's image vitally influences its development as the fourth most populous state.

Abstract worlds refer to concepts and ideas that will influence the future of the Sunshine State. It is a visionary outlook—similar to Walt Disney's concept when he decided to build in Florida. Few could have imagined the long-term effects of that vision, but it has certainly had an enormous influence on the state.

To review the historical geography of Central Florida, I have highlighted three different time periods. With each of these periods I will attempt to reconstruct the past patterns of real geography. In addition, I will refer to the images that have dominated the development of the region. To complete the historical study, I will mention ideas and concepts influencing future geographies. These cross-sectional time swaths vary considerably in length. I chose them on the basis of reasonably homogeneous human activity patterns, and because major shifts in that activity occur at the beginning of each period.

Central Florida: 100 AD- 1500 AD

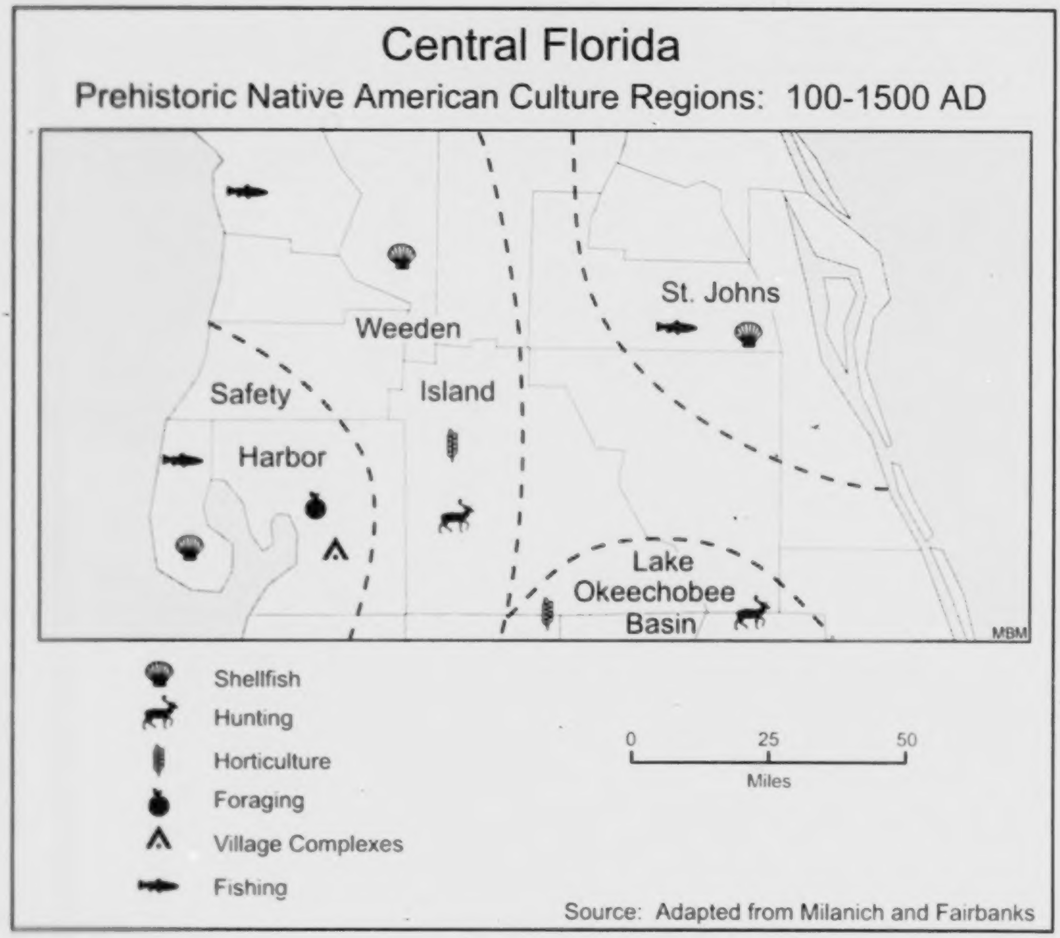
The first period in this quick swing through the historical geography of Central Florida is prehistoric. We have no contemporaneous records from that time, which forces us to face the formidable task of reconstructing spatial patterns on the basis of archeological evidence and supposition. The task is challenging and our conclusions remain tentative. Prehistoric Native American life, however, deserves attention. Their occupance of the Florida peninsula, for approximately 15,000 years, dwarfs the 500 years of European- based settlement.

The chronology, origin, diffusion, population, and life of prehistoric Americans in Central Florida is an integral part of the larger-scale story of the beginnings of human life in the Americas. Much remains to be discovered about early Native Americans, and the topic is somewhat controversial. Until recently the generally accepted date for arrival of humans in this hemisphere was about 15,000 years ago by way of the Bering Strait. Growing evidence suggests that people reached the Americas by a number of other routes across the Pacific as well as the Atlantic, and considerably earlier than formerly thought possible. Suggestions of evidence of human life in Central America have been estimated to have occurred as early as 45,000 years ago. We have no definitive answer to these questions at present. One stumbling block to further investigation has been an understandable Native American sensitivity to disturbing archeological sites. A portion of Native American religious belief attributes the origin of humankind to physical features. Certain tribal groups believed that they originated in the earth, on a highland, from a special lake, or other natural features. Examination of sites, and particularly exhumation of human remains of Native Americans in Central Florida, is a controversial topic in this broader context.

If the original inhabitants of Florida came overland from the north and west as most scholars suggest, they were certainly off the presumed beaten track of prehistoric American humankind running north and south parallel to the west coast. In addition, they arrived in a land that was different than their supposed preference for open spaces with high animal concentrations (Butzer 1990: 29). Florida was not particularly open and its animal life was primarily in marine resources. By the time of our first chronological cross section, approximately 2000 years ago, Central Florida's physical geography was quite like it is today. The interior areas of Florida, particularly to the north of our areal focus, are heavily wooded with pine trees. Much of this land along the central Florida highland is dry and has poor soils. Not much native animal life is here either. In a similar fashion, sandy beaches along both coasts are poor areas for sustaining human life.

Aboriginal peoples seem to have found their most reliable resources around the wetlands of Florida. Fish and shellfish, a variety of plant life, and some animal concentrations supported human life in such places. Perhaps it was distance from the west or lack of open land, for whatever reason, it is thought that the native American population of Florida was relatively small during this time period (Milanich and Fairbanks 1980: 18). Although some population estimates are as high as 100,000 people at the time of European contact, others suggest figures as low as 25,000 (Tebeau 1971: 16). Whatever the exact figure, relatively few people lived in this far southeastern peninsula. Those that were there were divided into numerous tribes, with the majority of them found in the northern and panhandle sections.

Some regional organization among Native Americans in Central Florida began in the 1500 years before arrival of Europeans (Figure 2.1). This is a transitional zone on the peninsula, an area at the juncture of the highlands to the north and the Lake Okeechobee region to the south. Traveling in an east-west direction also takes one from ocean to gulf environments. On this physical stage Native American peoples occupied relatively small areas. On the east side of the peninsula small groups occupied coastal lagoon and interior riverside locations. These were fishing, shelling and hunter-gatherer peoples. To the south, in the Okeechobee margins, some farming occupied lands drained by small ditches. The Weeden Island culture was found all along Florida's gulf coast, with more populous groups farther to the north and west. Around Tampa Bay, where tidal areas provided extensive areas of marine resources, were most of the prehistoric Indians of Central Florida. Near the time of European contact these people had established trade connections as far away as the Mississippi Valley. They had relatively large village complexes and temple mounds for defense and religious ceremonies.


Central Florida

Prehistoric Native American Culture Regions: 100-1500 AD

Source: Adapted from Milanich and Fairbanks

Figure 2.1

During these times we find initial evidence of Central Florida's regional identity crisis, a theme in the region's human geography that continues until the present time. In all directions there is some dominant physical feature—ocean, gulf, ridge, lake—with Central Florida having no dominating physical feature between all the rest. Central Florida is heterogeneous in its physical landscape. This early human spatial differentiation, based on different cultures making varied uses of individual resource complexes, continued after initial human occupation.

Central Florida: 1500 AD- 1900 AD

For Europeans, Florida was mostly an obstacle, a hindrance to progress both physically and mentally. Latin European nations sponsored the earliest explorers. They directed most of their efforts further to the south, in Central America, the equatorial lands of South America, and the Caribbean. They sought lands, personal wealth, and the salvation of heathen peoples for royal regimes and the Roman Catholic Church. In order to maintain this empire, they had to establish reliable transportation routes back to mother countries. The normal route to Europe from the New World, ran eastward along flowing ocean currents, with the prevailing winds, around the keys and parallel to the Atlantic coast of Florida. Treasure fleets transporting cargoes from the Pacific as well as Latin America struggled with passages through the Florida Straits during hurricane season and then northward with the Gulf Stream. Lost vessels and lives were a frequent occurrence because Florida was literally in the way.

What to do about Florida was a mental or image challenge. Although most Americans think of Florida as a *southern* location, to Latin colonizers Florida was a *northern* borderland. The first half of the sixteenth century was spent trying to figure out what to do with it. Several early expeditions to explore this peninsula and nearby lands, some of which landed in the Tampa Bay region, were unsuccessful in that they found no precious metals, relatively few indigenous inhabitants, and overwhelming challenges to overland travel. In the long run, however, Florida could not be ignored because of its proximity to important routes, and the possibility that the French or others might occupy it. Such occupation would pose a continual threat to the safety of Latin fleets.

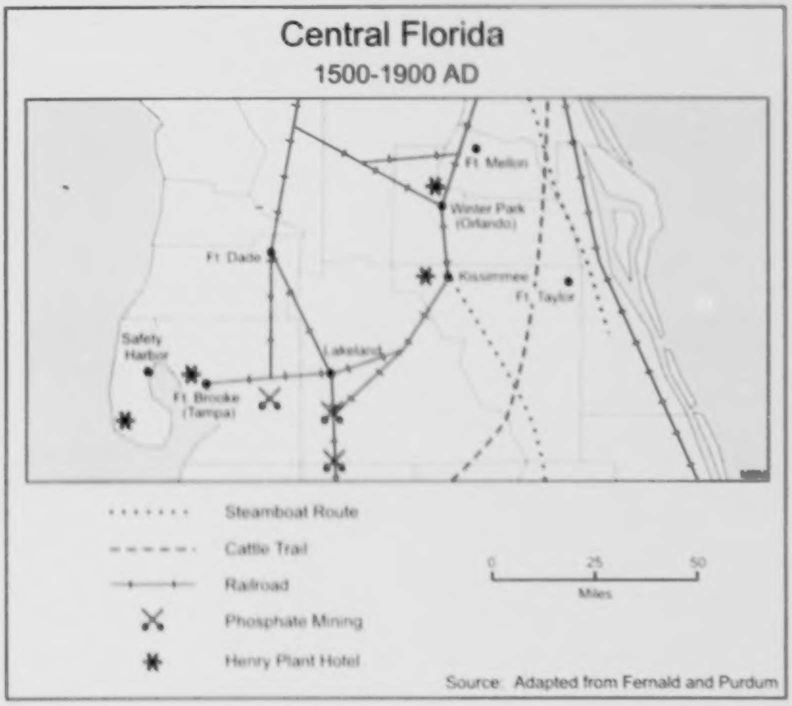
Following several failed attempts at settlement, Florida was permanently colonized by the Spanish in 1565 at St. Augustine (Gannon 1993). This began a period of two hundred years of Spanish rule, followed by a short British period in the late 1700s, another Spanish period, and the eventual acquisition of Florida by the United States in 1821. Those first three hundred years of European occupance constituted a colonial period, most of the time under the control of a nation different from the one that had earlier ruled the thirteen colonies to the north. Florida was a transitional zone between northwest European powers to the north and Latin European countries to the south. In the new world the enmity of the European past was spread out over a greater territorial area. Northern European countries controlled most of North America, southern European countries controlled most of South America, and the Caribbean region was in between. In addition, Florida did not appear to be such an attractive possession compared with the more populous and natural resource-rich areas farther north and south. Spain never successfully organized their colony in Florida. Whereas many northern Europeans rushed to settle the thirteen British colonies, few people from anyplace could be convinced to settle in Florida. On the other hand, nobody can afford to ignore a border area. A political vacuum in space is not sustainable. If European nations were not going to exercise effective power over Florida, somebody would. By the end of the first quarter of the nineteenth century the inevitable had happened, an aggressive new nation had taken over.

Florida's new status as a territory of the United States did not automatically solve its settlement blues. Two things stood in the way of immediate, massive settlement activity. First, sectional differences in the area to the north were already apparent, and would eventually lead to war. Florida, on the periphery of the South, would be drawn into this conflict on the losing side. Second, Spanish colonial practice unintentionally led to elimination of the aboriginal Native American population. In their place came other Indian peoples from the southern Appalachians. American policy toward these peoples would be as discriminatory as it was to the Indians in the path of westward expansion—confinement to less desirable areas and eventual deportation.

Central Florida experienced some relatively minor settlement during the nineteenth century, particularly in comparison to the northern areas. Ironically, the initial impetus for Anglo settlement had to do with destruction of Native American settlement (Mahon 1967). During the later years of Spanish rule in Florida, Americans had launched a number of raids into the colony against Native American areas. The pretext was that they were a potential danger to Southern settlements north of the border and a haven for escaped slaves. When the United States took over it was generally assumed among Americans that Indians would not stay in Florida. Americans everywhere were in the midst of expansion justified by manifest destiny. Native Americans would not be allowed to stand in the way of this movement, and certainly not in Florida.

During the 1820s representatives of the United States with various Native American groups and individuals conducted a series of treaty negotiations. The purpose of these negotiations was to confine Indian location and movement, and guarantee separation from Anglo-Americans. The Treaty of Moultrie Creek in 1823 established a "Seminole reservation" of approximately four million acres (1,660,000 ha) that covered a considerable portion of the Central Florida Highlands from a line near present day Ocala, in the north central part of the peninsula, south to the area north and west of Lake Okeechobee (Mahon 1967: 46). The east and west sides of this reservation were generally parallel to, but away from the coast. Treaty negotiations with Native Americans in Florida, as elsewhere, were always characterized by uncertainties of leadership and lack of mutual respect. The resulting reservation established a situation in which Indians were not only isolated, but also surrounded. This was hardly a hopeful situation.

The Native American reservation passed through the middle of Central Florida (Figure 2.2). Military posts established during this period are found near both coasts and are the first locations of significant Anglo settlement in the region. Ft. Brooke, the present day location of Tampa, was founded in 1824. With the onset of the Second Seminole War in 1835 military presence increased at these posts. Along with the military came civilians to support their operations, settle towns, and eventually locate on rural lands. By 1842 most Indians had been pushed out of Central Florida, either through shipment to the West or retreat to the wetlands surrounding the Everglades to the south. The military period had promoted establishment of transportation routes through the region. By the end of the nineteenth century Henry Plant and Henry Flagler had constructed railroads to the Gulf coast as well as along the Atlantic to the southeast. Agricultural activity increased with establishment of some citrus groves in a few coastal locations and general farming around growing towns. Cattle ranching in the region and further south produced livestock that moved north along a cattle trail parallel to the Atlantic. Phosphate mining developed in west central Florida supplying fertilizer needs in far flung areas.



Source: Adapted from Fernald and Purdum

Figure 2.2

In spite of these nineteenth century developments, and throughout this second time period, until roughly 1900, Florida settlement as a whole was centered in the northern and panhandle sections of the peninsula (Fernald and Purdum 1992: 96). Even there, the population of Florida was sparse. Florida's population in 1900 totaled approximately half a million, with the largest city, Jacksonville, containing only 28,000 inhabitants. Central Florida's population was much less than the area to the north, and her cities smaller. The largest was Tampa with a population of approximately 16,000. This was an unusually high figure for a city in a relatively unpopulated region and was attributable in part to military activities supporting the Spanish American War (Bane and Moore 1981). Orlando, in a poor agricultural setting and away from the coast, was the largest inland city in Central Florida. Settlement activity beginning and ending the nineteenth century in Central Florida had a distinctly military flavor.

Central Florida: 1900 - 1950

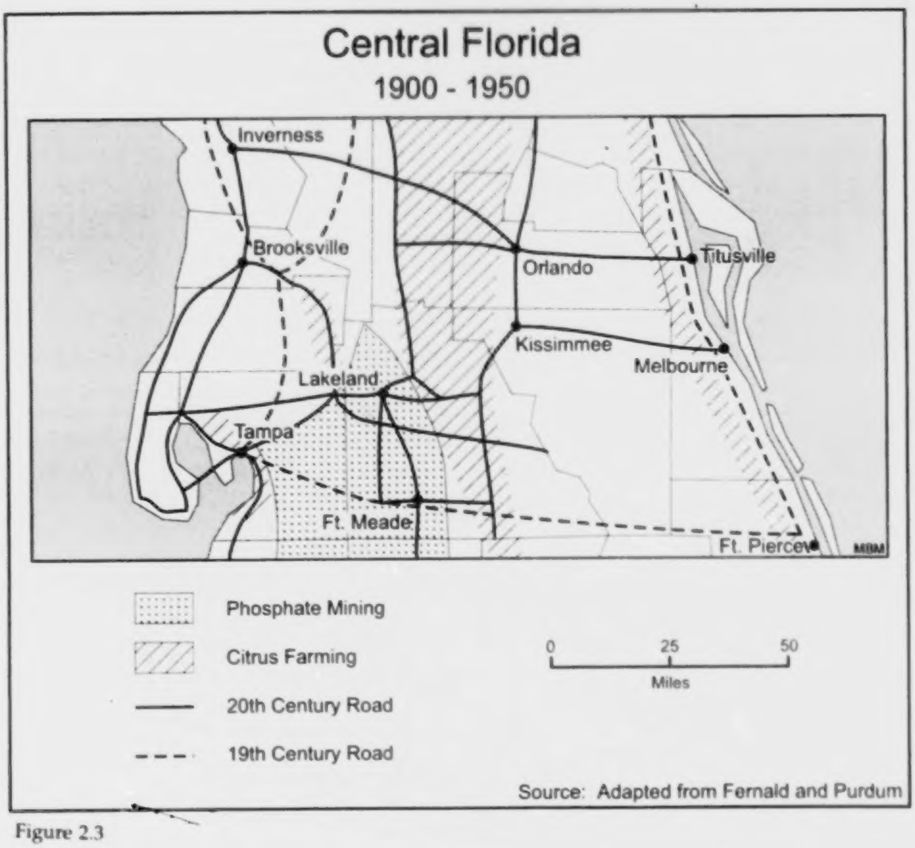
The twentieth century began with Central Florida continuing to develop its character as a heterogeneous transitional area between the developed northern and sparsely settled southern portions of the peninsula. Differences between the eastern and western sides of the peninsula would continue to grow during the first half of the twentieth century, as Tampa grew into a major metropolitan area with no corresponding urban agglomeration on the east coast. The Tampa Bay region, with a relatively good agricultural hinterland and a fine port dominated Central Florida urban statistics.

People had traveled to Florida for vacations in previous times. Some of the fairly well-to-do took coastal steamers to various locations along the coasts. Others traveled along inland waterways and visited natural springs and spas. The panhandle portion of Florida attracted a regular flow of visitors to its Gulf beaches from the Deep South.

Several things had to change for Florida to become a major tourist destination in the early twentieth century. First, mass transportation had to improve to the point where large numbers of people could travel throughout the peninsula for relatively cheap fares. The railroad era, delayed in its Florida appearance because of the Civil War and the difficult reconstruction era that followed, arrived with full force at the end of the nineteenth century. Along the west coast large numbers of travelers could now enjoy recreational facilities in the Tampa Bay region. Along the east coast, winter weary visitors passed through the region on their way to destinations further south. A land boom in southern Florida in the 1920s quickly changed to a bust. However, the stimulus to travel to southern portions of the Sunshine State would not go away because of an economic downturn.

Interestingly enough, the major twentieth century economic downturn, the Great Depression of the 1930s, led to socio-economic changes that would benefit growth in Florida. Establishment of a safety net for working people became one of the major goals of government, and to a certain extent of private enterprise, during those years. An important element of this safety net was provision for retirement years. Retirement programs, starting with social security and including other types of pension plans, became a standard feature of employment. For the first time the middle class could not only visit Florida but also retire there. Coastal locations were favored for retirement, but were also the most expensive. Less costly retirement locations could be found all along the Florida highlands, which passes through this region, and in special interior locations. Highways to southern tourist and retirement locations passed through central Florida, with numerous facilities and employment opportunities.

Central Florida in the first half of the twentieth century was affected by general transportation and tourism throughout the peninsula (Figure 2.3). The road system of Central Florida reached into sparsely settled sections, as well as provided for large scale travel passing through the region. Major U. S. routes, including numerous sections of dual highway, parallel both coasts as well as provide for movement across the peninsula. Right after this period the Federal government decided to plan and support development of an Interstate Highway System. The basic plan called for linkages between major metropolitan areas. Central Florida would eventually have an Interstate Highway connecting the coasts, as well as north-south Interstates providing Tampa and Orlando connections to the Miami metropolitan region to the south as well as Jacksonville, Atlanta, and New Orleans toward the north and west.



Source: Adapted from Fernald and Purdum

Figure 2.3

As in most southern states, Florida delayed introduction of effective land use regulation until the latter part of the twentieth century. Comprehensive land use plans, where they existed, were modified so often that they became relatively worthless. A result of this was rampant urban sprawl, highway congestion, and widespread commercial strip development along most major highways in moderately to densely populated regions. Mobile home parks were established in increasing numbers along the less expensive rural fringes of metropolitan areas. Central Florida has its share of places that exhibit these features. Particularly in the region around Tampa Bay, uncontrolled growth threatened to erode the quality of life in a state that counted on maintaining attractive physical and human environments in order to attract visitors and spur economic development.

Railroads, and to some extent the highway system, provided a means for moving Central Florida resources to market. The central highlands experienced large scale citrus grove development, most of which was supported by extensive fertilization and irrigation. Citrus could afford this level of support because it could be transported easily to northern markets. Other fruit and vegetable production occurred in Central Florida during this period. Most was located on better quality soils near Tampa and around Orlando. In general, the southeastern quarter of Central Florida, as shown on these maps, is a poor agricultural region because of poor soils. It remained a sparsely settled region throughout the first half of this century. Fertilizers for Florida fruits and vegetables were not hard to obtain. Extensive phosphate deposits to the east of Tampa were mined heavily at this time. In addition to Florida, phosphate found markets in many far flung regions of the United States through extensive use of railroad transportation.

Conclusion

Yes, there clearly was life, and many distinctive human spatial patterns, in Central Florida before the arrival of Walt Disney. Central Florida was not like other places in Florida during these three time periods, nor since. In effect, it has always been a land betwixt and between. It is a distinctive physical setting, a place where the central Florida highlands fade out as they get closer to Lake Okeechobee. On either side are coastal plains, with the western side including a magnificent, large harbor.

Central Florida's historic transitional character, however, is most attributable to the human geography of Florida. In the beginning of human occupation of the peninsula, Native Americans were centered further to the north. Early European arrivals concentrated their settlement efforts to the north as well. When the United States took over the Florida peninsula, Central Florida became a borderland. In fact, one could have seen an identifiable succession of people who chose or were pushed from north to south here. Native Americans retreated southward before the onslaught of Anglos. Anglo settlers pushed southward through Central Florida to acquire more land and reached the warmer lands farther south on the peninsula. Twentieth century arrivals from the South settled in North Florida while Northerners traveled through Central Florida to settle along the lower Atlantic coast. Midwesterners retired in large numbers in the Tampa Bay region.

As we have seen, this transitional, heterogeneous, middling area on the Florida peninsula is too complex to describe with a few words. Central Florida did not have much of a public image by 1950. The area is not like the Sun Coast, nor Everglades, nor Panhandle, nor any other relatively homogeneous region in the State. When we construct a list of characteristics of Central Florida at mid twentieth century we can recognize why it was so attractive to Disney. The fact that Central Florida, and particularly east Central Florida, had not attracted large numbers of inhabitants meant that extensive lands would still be available for acquisition at relatively modest prices. The fact that parts of Central Florida lagged behind development of the rest of the State meant that the legislature would be inclined to grant Disney special decision making powers over their property in order to bring economic development to the region. The fact that this modestly settled region was close to beautiful natural resources like Atlantic beaches as well as interior lakes and streams meant that Disney visitors would not have far to go to spend some vacation time in natural settings. The fact that Central Florida straddled land transportation routes to South Florida meant that Disney could entice tourists going south to stop and enjoy their attractions.

A review of the historical geography of Central Florida reveals that this distinctive region of varied physical and human patterns was a natural to experience economic take-off in the last half of the twentieth century. That transformation would leave it a significantly changed land, a place with many destinations to travel to, settled at, as well as pass by on the way to and from South Florida.

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3

The Landscapes of Kissimmee and Osceola County

Ray Oldakowski

The state of Florida has experienced unprecedented population growth during the last fifty years. In 1950, the state's population was just under 3 million people, ranking it twentieth among the 48 states. By 1995, Florida had a population of more than 14 million people, and was the fourth largest state in the country (University of Florida 1995).

This growth has produced enormous changes in both the natural and built environment of Florida. It is not uncommon to hear residents comment on how their neighborhood, community, and city have changed over the past few years. Tourists marvel at how an area can change so dramatically in the short period of time since their last visit.

These changes can be observed and understood by examining the landscape. Although geographers have many definitions for the word *landscape*, we refer here to the *cultural landscape*, the landscape made by humans. Noted cultural geographer Peirce Lewis (1979) states "Sometimes Americans may notice cultural landscape because they think it is pretty, or perhaps ugly; mostly they ignore the common vernacular scene. For most Americans, cultural landscape just is." He also argues that although the cultural landscape often goes unnoticed, it has meaning. It reveals the activities, tastes, preferences and values of those who create it.

Central Florida's landscape is brimming with evidence of the population and economic growth the region has experienced over the last several decades. Southern Orange county, with its seemingly infinite supply of hotels and motels, restaurants, and entertainment attractions illustrates how the area has evolved into one of the most popular tourist destinations in the world. The skyline of downtown Orlando (although still quite modest when compared to other metropolitan areas) has grown considerably over the last several decades. It demonstrates the growth of the banking, finance, and other office related sectors of the economy. Perhaps the most conspicuous component of that landscape, is the new Orange County Courthouse, more than 400 feet and 24 stories tall, is symbolic of the wealth the county has accumulated as a result of the tourism boom and other economic growth. The sprawling housing developments of Seminole County illustrate its staggering population growth (more than tenfold since 1950), and its role as a residential or bedroom suburb of the Orlando Metropolitan area.

This chapter will focus on another example of the landscape of Central Florida: the Kissimmee area of Osceola County. It is located to the south and west of Walt Disney World, and to the south of Orlando (Figure 3.1). The Kissimmee area serves as both a representative and unique laboratory in which to study the landscape. It is representative, because it demonstrates many of the landscape components and changes that can be seen throughout Central Florida as a result of population and economic growth. It is unique, because the landscape of the Kissimmee area has developed quickly and dramatically. No one could have imagined the major changes in the landscape that have occurred in the 25 years since the opening of Walt Disney World. This includes the transformation of US Highway 192 (US-192), from a relatively insignificant and moderately traveled east-west link across Osceola County, to a 12-mile stretch devoted almost entirely to tourism and the hospitality industry. In addition, thousands of acres of residential development have resulted in more than 10,000 new dwelling units to house those who have migrated to the county because of its robust economic conditions.

We will begin with a brief overview of Kissimmee and Osceola County, including history, and current geographic, demographic, and economic conditions. We will then undertake an in-depth examination of two specific landscapes in the Kissimmee area, to see how these landscapes reflect the people, activities, and culture of the area.

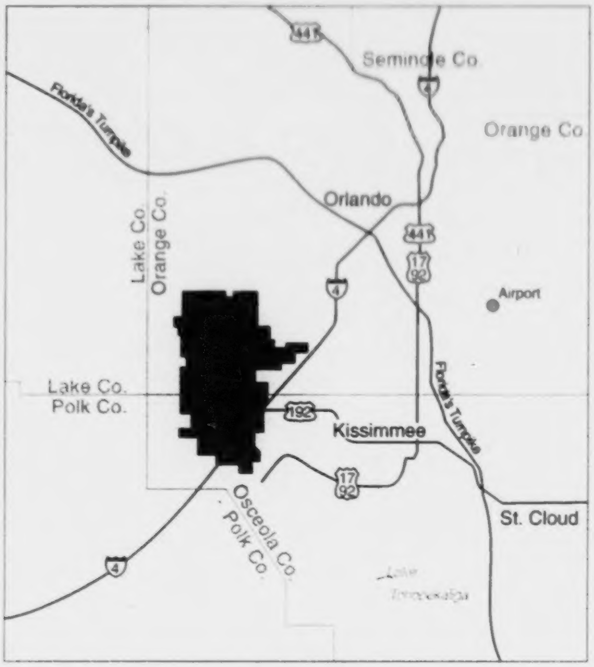

Figure 3.1: Orlando Metropolitan Area

Study Area

The name Kissimmee means "Heaven's Place" and is attributed to the Caloosa Indians, who roamed this region of Florida long before the Spaniards explored it. The area remained largely uninhabited until the 1880s when Hamilton Disston, a Philadelphia investor, purchased 4 million acres (1.7 million ha) of Central Florida land stretching from Orlando to south of Lake Okeechobee. Disston's workers lowered the water table, and made the land suitable for farms and pastures. The Florida land boom of the 1920s and the post World War II period generated modest growth within the area (Kissimmee-Osceola County Chamber of Commerce 1996).

Until 1970, Kissimmee could best be characterized as the population, economic, and government center for a sparsely settled rural county in Central Florida. The area was known primarily for agricultural activity. Cattle ranching accounted for more than two-thirds of the county's land area, and the citrus industry comprised the largest component of harvested crop acreage. In addition, the county contained two large wildlife management areas. At that time, Osceola County's population barely totaled 25,000 people, with less than 10,000 living in Kissimmee (Table 3. 1). The county's population growth lagged compared to the rest of the state during the 1960-1970 period. With the opening of Walt Disney World in 1971, Kissimmee and Osceola County began to experience the astonishing population and economic growth it continues to enjoy today.

Kissimmee is one of two municipalities located in Osceola County, the other being St. Cloud (Figure 3.1). Both cities are located in the northwestern corner of the county, approximately twenty miles south and clearly within the urban realm of Orlando.

Although all areas of Central Florida have been affected by the tourism boom that began in the 1970s, Kissimmee and Osceola County have experienced the greatest transformations. A series of investigative reports by the *Orlando Sentinel* (Millican 1995) concluded that "the only real constant in Osceola County over the past 25 years has been change." Several of the specific changes resulting from this transformation follow, as they will be of importance later as we attempt to examine the landscape.

First, the population of both Kissimmee and Osceola County have doubled during each of the last two decades, and they are expected to grow by another 50 percent during the 1990s (Table 3.1). Nearly 90 percent of this population growth is attributable to migration, and that suggests that the characteristics of the resident population have changed as well. The population is younger, as there are now more families with children. In 1970, Osceola County had a median age of 40, it is now under 34. The average education and income levels for the county have increased. Although the population of the county remains predominately white (more than 90 percent in the 1970, 1980, and 1990 censuses), it has become more ethnically diverse. Nearly 15,000 persons are of Hispanic or Asian origin. The *Orlando Sentinel* (Jacobson 1996) characterized the area's new age of multiculturalism as follows: "Twenty-five years ago, Vine Street's (US-192) only restaurant offered Southern Fried chicken. Today, 87 eateries serve the bird cooked in internationally diverse ways."

Second, the economy of the county has changed dramatically. Agriculture is no longer the area's primary source of revenue. Because of the tourism boom and the phenomenal population growth, the construction industry is vibrant. Housing developments such as Buenaventura Lakes and Poinciana, which feature affordable single family housing, have resulted in the construction of more than 10,000 new homes in the county since 1970. Local community leaders have also actively encouraged the development of upscale residential communities such as Disney's Celebration (slated for 3,500 single family homes) and Formosa Gardens (located south of the Splendid China theme park). These properties, and other similar residential developments in West Osceola, are expected to add billions of dollars to the county's tax roll over the next two decades (Sargent 1995).

The hospitality industry (which includes hotels, motels, and restaurants) and related retail activity represent the largest component of the local economy, in both labor and revenue. A few relevant statistics help to underscore the magnitude of the tourism boom. In 1970, Osceola County had 23 hotels and motels comprised of approximately 500 lodging units. By 1995, the county had 128 hotels and motels with more than 20,000 lodging units. In 1970, 71 food service establishments were in the county with a seating capacity of approximately 2,600 persons. Today nearly 500 food service establishments can seat more than 50,000 guests. Finally, in 1970, Osceola County was host to approximately 37,000 tourists. The county now averages nearly 5 million visitors per year.

Table 3.1: Population of Kissimmee and Osceola County (in thousands)

	1960	1970	1980	1990	1995
Kissimmee	7.0	7.1	15.5	30.3	37.2
Osceola County	19.0	25.3	49.3	107.7	136.6

Source: *Florida Statistical Abstract* 1995.

Reading the Landscape

We will examine two areas of primary interest in the landscape of Kissimmee and Osceola County. The first is US-192, an east-west artery that roughly parallels the border between Osceola and Orange counties—the main gate to Walt Disney World is located on US-192 at the western fringe of Osceola County (Figure 3.2). Called the county's lifeline, it has also been designated by regional planners as an activity center for retail and hospitality services. The second is downtown Kissimmee, which is focused around US Highway 17/92 (US-17/92) or Main Street, a north-south artery.

Although these two streets intersect at the approximate geographic center of Kissimmee, they represent two completely different worlds. US-192 represents the new Kissimmee, the Kissimmee that symbolizes tourism, the Kissimmee best known by its visitors. Downtown exemplifies the Kissimmee of old, the Kissimmee that was a quiet, slow paced community, the Kissimmee pre-Disney residents wish to preserve.

To guide us in examining and interpreting the landscape, we will use a framework proposed by Peirce Lewis (1979) shown on Table 3.2. He refers to these guidelines as "axioms" or "essential ideas that underlie the reading of America's cultural landscape." Many researchers have found this framework to be of great value in examining a variety landscapes. One should also remember that all landscapes are different, and each individual may interpret a landscape differently (Meinig 1979a), i.e., certain axioms are more applicable in certain landscapes than in others. It is unnecessary to force an axiom to apply to a particular landscape, or vice-versa. Simply use these guidelines whenever you feel they are appropriate, and they will help to enhance your understanding, appreciation, and enjoyment of any landscape.

The Axiom of Landscape as a Clue to Culture. Simply stated, all things in the cultural landscape provide a clue to culture. Humans designed, built, and placed them there for a reason.

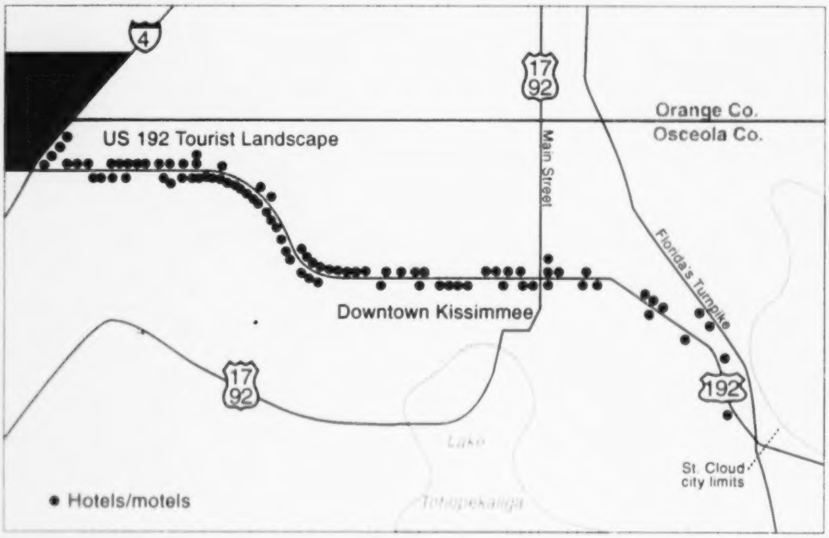

Figure 3.2: US 192 and Downtown Kissimmee

Table 3.2: Axioms for Reading the Landscape

1. **The axiom of landscape as a clue to culture**
   The corollary of cultural change
   The regional corollary
   The corollary of convergence
   The corollary of diffusion
   The corollary of taste
2. **The axiom of cultural unity and landscape equality**
3. **The axiom of common things**
   The corollary of nonacademic literature
4. **The historic axiom**
   The corollary of historic lumpiness
   The mechanical (or technological corollary)
5. **The geographic (or ecologic) axiom**
6. **The axiom of environmental control**
7. **The axiom of landscape obscurity**

Source: Lewis 1979.

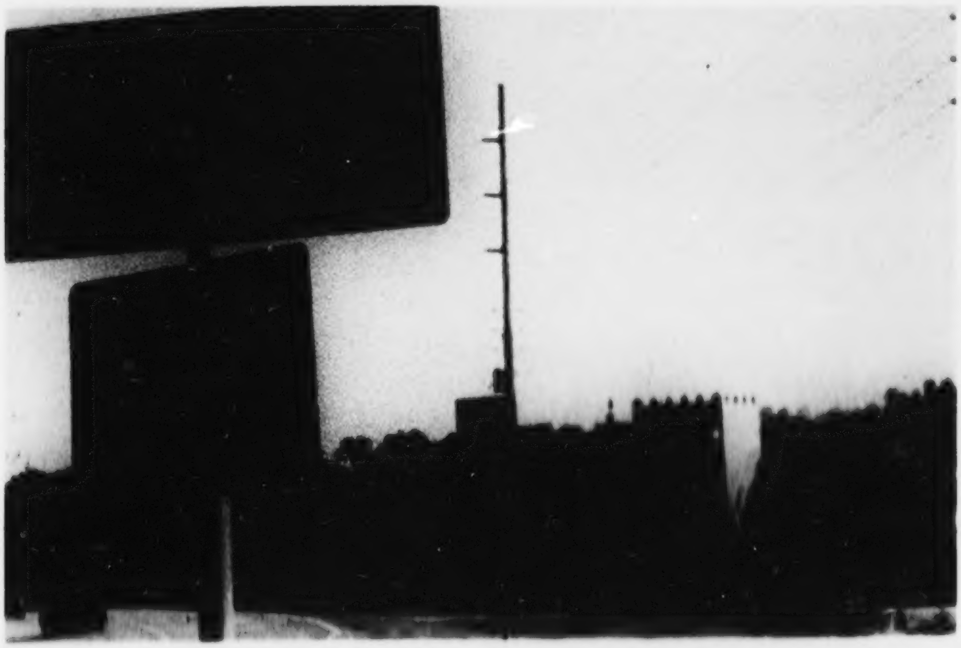

Figure 3.3a: Medieval Times signals the start of the US-192 tourist landscape

Figure 3.3b: Motels, restaurants, and gift shops along US-192

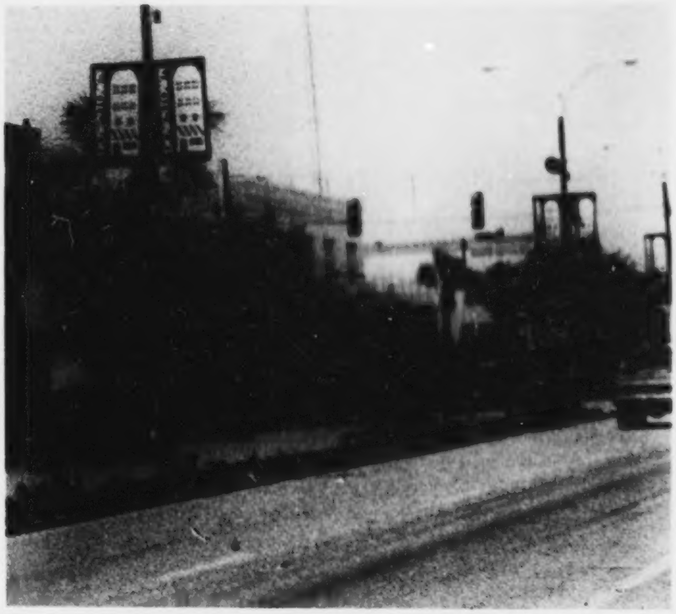

Figure 3.4a: The storefront shops of Downtown Kissimmee

Figure 3.4b: The small town atmosphere of Downtown Kissimmee

As one travels along US-192 through western Osceola County and Kissimmee, many conspicuous clues emerge regarding the aspect of culture that dominates this roadway—tourism. Almost everything has been designed to meet the needs of the visitor: lodging, food, entertainment, and gifts (Figures 3.3a and 3.3b). The roadway is presented as a corridor. Cultural geographers have referred to this design as a vista, a linear place of distinctive form that limits the channels of vision (Jakle 1987). Signs advertising each establishment appear along the sides of the road, and one can see all businesses clearly seen from a moving vehicle. Ornate distance markers, placed at half-mile intervals, assist visitors in finding or returning to places of interest. The road is wide, varying from four to eight lanes. Although a median separates the county-owned segment of the road, frequent breaks allow access to both sides. The city-owned segment of the road provides complete access to both sides with a center turn lane. Numerous traffic signals regulate the flow of motorists, and allow the traveler to process the landscape they have just seen, and gain a stationary glimpse of what lies ahead. Little is presented on intersecting roads that might divert the motorists eyes and attention away from US-192. Finally, although the roadway has the theme of tourism and linear organization, little order is apparent for its presentation. Signs are of different sizes, shapes, and heights. Motels may be located adjacent to other motels, or flanked by eating establishments or gift shops. Some establishments are located almost directly on the roadway, others are set slightly back, still others are located on frontage roads.

Downtown Kissimmee presents many clues to the culture of the past, a slower paced community that served as a regional center for an agricultural county. Main Street contains approximately three blocks of small storefront shops, businesses, and restaurants organized in a walkway fashion (Figures 3.4a and 3.4b). Although it is a four-lane road, it receives a fraction of the traffic found on US-192. Tourists seldom visit this downtown business district, although local leaders and planners are attempting to lure them to the area by promoting the historic, small town atmosphere. A recent publication by the Kissimmee-St. Cloud Convention and Visitors Bureau (1996) states: "Both Kissimmee and St. Cloud feature quaint historic districts which are ideal for walking tours, antique browsing, shopping, dining, and sightseeing." In the downtown area, one can find the city hall, public library, police station, and public parks, all representing the sense of community absent from the US-192 area. Downtown Kissimmee contains the Monument of States (Figure 3.5)—a collection of rocks from 48 states and 22 foreign countries, with many of the stones signed by state governors and foreign ministers. The stones are set in a concrete-step pyramid consisting of 21 tiers. Ironically, this monument was arguably Osceola County's most unique and memorable tourist attraction until the arrival of Mickey Mouse, the Arabian Knights, and the American Gladiators on US-192.

The Corollary of Cultural Change. Lewis states that an existing cultural landscape represents a great investment of money, time, and emotion. Major changes in the landscape are generally the result of a corresponding major change in culture.

US-192 is a perfect example of this corollary. As the primary sector of the economy of Kissimmee and Osceola County changed from agriculture to tourism, the landscape changed as well. Fields, pastures, and woodlands were rezoned and quickly converted to the staples of the hospitality industry. In fact, parcels of undeveloped land are an uncommon sight on US-192. This shift in the economy also represents a more fundamental change in the attitudes or culture regarding growth. By embracing tourism, civic leaders have expressed a preference for the resulting population and economic growth, rather than the stability (or perhaps stagnation) of the previous agriculturally- based economy.

Cultural change is evident in the landscape of Downtown Kissimmee as well. These changes represent the new-found wealth brought about by increased revenues generated by tourism. Main Street has been widened and repaved with a neatly manicured median of flowers and trees located in the center. Antique style street lamps line the sidewalks. New and uniformly designed park benches and waste receptacles are present throughout downtown. Even more impressive, the city has built a new civic center, library, and police station in downtown in just the past seven years.

The Regional Corollary. Lewis states that landscapes in different regions of the country look different not only because of physical geographic factors such as climate or topography, but also because the cultures are different. He also asserts that these landscape and cultural disparities can even be found in smaller geographic units, such as cities.

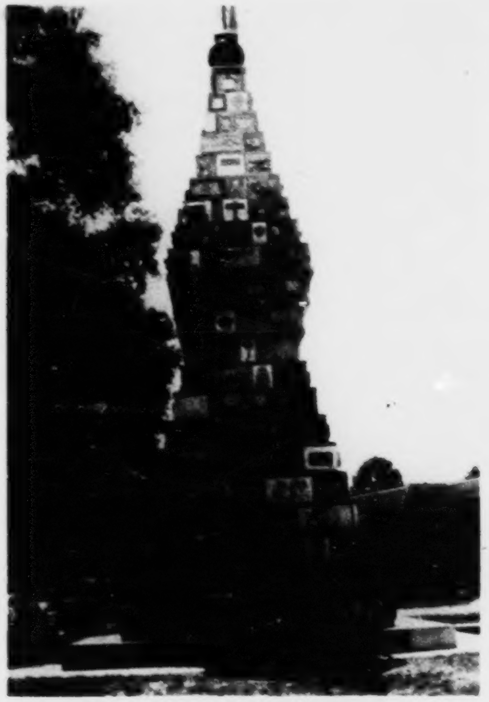

Figure 3.5: The Monument of States

Given that our examination of US-192 and Downtown Kissimmee is based on the fact that landscapes and cultures can vary, even within a city, let us pursue this regional corollary at the broader, national level. Depending on the specific region considered, a moderate degree of regionalism is apparent in the US-192 landscape. For example, if the term "The Sunbelt" were to be used, our tourist roadway demonstrates some of the characteristics commonly associated with that region. Most of the buildings and structures are new and modern in their appearance. The road itself, especially within the city limits of Kissimmee, is wide and neatly paved, with modern street lights and street signs. There is also the sense of economic vibrancy associated with the Sunbelt. If the term "The South" were to be used, little evidence is apparent of the characteristics associated with that region. Except for an occasional barbecue (or numerous shortened spellings of the word) restaurant or Florida souvenir shop, little else indicates that one is in the southern United States. Two other features of US-192 impede a sense of regionalism. The first is the proliferation of national franchises (e.g., Holiday Inn, Denny's, or Walmart) that can be found in any part of the country. It has been argued that these ubiquitous establishments provide travelers with the appearance of a common landscape, allowing them to feel more comfortable in places away from home (Sopher 1979). Second, is the use of themes associated with other parts of the country and the world for entertainment attractions. US-192 offers Splendid China, the Arabian Knights, Medieval Times, Congo River, Wild Bill's Fort Liberty, and the American Gladiators. There are also numerous ethnic restaurants (especially Oriental and Latin cuisine), pubs that display the Union Jack, and motels that proclaim that they are British owned (Figure 3.6).

Downtown Kissimmee as well displays little evidence of regions such as The Sunbelt or The South. Perhaps more appropriate, is that the downtown area attempts to create a quiet, small town, rural atmosphere. Simple wooden signs advertise downtown businesses such as the hardware store or barber shop.

The train station is located in this area, and is adjacent to parks and recreational fields. Lake Tohopekaliga with its fishing pier and picnic pavilion can be see to the southeast. Single-family homes fringe the immediate downtown area with wooded yards showcasing cypress and oak trees. In these ways, Downtown Kissimmee presents an ambiance of rural America that can be found in most any region of the United States.

The Corollary of Convergence and the Corollary of Diffusion. Sometimes the cultural landscapes of different areas begin to look more and more alike. For example, many of the residential suburbs in Central Florida are similar in appearance to those of Southern California, an area often considered to be the hearth of the modern American suburban landscape (Meinig 1979b). This is usually the result of convergence or diffusion. The former refers to growing similarities in previously distinct cultures. The latter refers to the spread of a culture from one area to another. In either case, the regional landscapes begin to appear more similar to each other.

When comparing the landscapes of Kissimmee to those in other areas of the country with similar activities, convergence is apparent. US-192 resembles other tourist landscapes in Florida and the United States. As was mentioned previously, the landscape of Downtown Kissimmee is similar to other small towns. When comparing our two landscapes to each other, little convergence appears. Both US-192 and Downtown Kissimmee have clearly demarcated boundaries, and each serves a different purpose. There is little reason for their human-made landscapes to interact. Formal planning and zoning regulations also hinder convergence.

Diffusion has occurred with the tourist landscape of the US-192. Since the opening of Walt Disney World in 1971, this landscape has expanded steadily eastward along US-192 from the Interstate-4 interchange to the Florida Turnpike interchange (Figure 3. 2). More recently, diffusion has also occurred westward from the Disney main gate to the border between Osceola and Polk counties. The diffusion of the tourist landscape occurs only linearly along US-192, and rarely extends north or south along intersecting roads. Again, this presents the tourist with a landscape that is easy to view and comprehend. Moreover, it also prevents the hospitality industry from infringing on residential and other areas of the city.

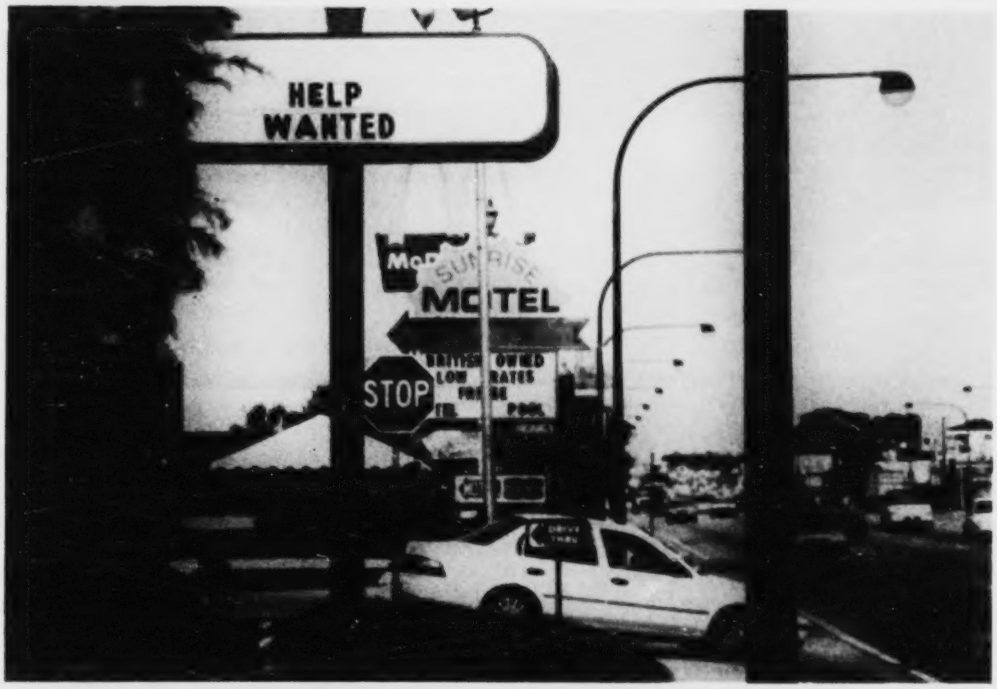

Figure 3.6: The international flavor of the US-192 tourist landscape

The Corollary of Taste. We have already seen how the landscape reflects the culture of the area in which it exists. The landscape will also reveal the tastes and preferences of that culture. The tourist landscape of US-192 clearly reflects the tastes of the American Family. The entertainment attractions are designed for families. From theme parks to water slides, from batting cages to miniature golf, activities are designed to be undertaken as a group, and to offer fun for both adults and children. Lodging is also family oriented. Most motels are designed around a pool, where one can find children splashing in the water and parents acquiring some much needed rest in the surrounding lounge chairs. Many motels also offer family-style suite lodging that accommodates up to six persons. Family style dining with buffets and moderate prices are common. Outlet malls and souvenir shops are geared towards family shopping. In addition, although many motels have lounges, we can find few bars, clubs, or other adult entertainment on US-192.

Given our discussions of Downtown Kissimmee to this point, one can clearly surmise the local tastes demonstrated in the landscape of that part of town. One is to create a sense of community through the intermingling of various types of landscapes. The single family homes, the storefront shops, the parks and recreation areas, and government buildings all coexist within the same small area. Another is to preserve historic value. Many of the residential and business structures were built decades ago. Although several of the government buildings (such as the library, civic center, and police station) have been built recently, they have been designed to blend in with the existing landscape. The city has also installed new street lighting on both US-192 and Main Street (thanks to the revenues generated by tourism). The lights on US-192 are of a modern geometric design, whereas those in downtown have the appearance of old fashioned street lamps from the turn of the century.

The Historic Axiom, the Axiom of Environmental Control and the Geographic Axiom. These axioms serve to remind us that three basic factors, history, the physical geographic environment, and geographic location continue to play a key role in determining the landscapes we see today. These factors are clearly more conspicuous in some landscapes than others. The influence of history is evident in the landscape of a New England colonial village. The influence of the physical geographic environment can be seen in a mining town of the Rocky Mountains in Colorado. The influence of location is apparent in a port city along the Mississippi River. Lewis (1979), however, argues that the effect of these factors can also be found in the ordinary landscapes of contemporary United States.

As we have mentioned several times throughout this chapter, history and historic preservation are common themes in the landscape of Downtown Kissimmee. The natural environment is also important, perhaps even showcased. Lake Tohopekaliga can be seen to the east from many downtown locations. It also serves as the focal point for parks, pavilions, piers, and other recreational facilities. Furthermore, the downtown area has maintained an abundance of trees and other natural vegetation. These can be found not only in the yards of residences, but beside buildings, in parks, and along the lakefront. Even the recently built police station, library, and civic center were abundantly landscaped with careful attention to the natural physical environment. Finally, the location of Downtown Kissimmee at the crossroads of US-192 and US-17/92, illustrates the importance of the U.S. highway system in determining the focal point of communities in times past.

Lewis (1979) also states that occasionally, history and geography are hard to find in the cultural landscape. Humans sometimes feel that they can conquer geography, i.e., build anything anywhere. In addition, humans may also attempt to ignore or erase history in creating new landscapes. This seems to be the case with the tourist landscape of US-192; the influence of these basic factors exists, but one must look closely to find them. History is not readily apparent. The majority of motels and hotels, restaurants, entertainment attractions, and retail centers have been built since the arrival of Walt Disney World. As one moves eastward toward the intersection with Main Street and the downtown area, one can find several older concrete-block houses (undoubtedly occupying lots that developers would quickly appropriate if made available to them). Traveling eastward beyond Main Street reveals additional older structures, as this portion of the roadway remains a mix between businesses for tourists and residents. Evidence of the physical geographic environment is also quite inconspicuous on US-192. The area has no change in elevation. Most of the fields and pastures of the previous agricultural era (which in themselves represented a human modification of the true natural landscape) have been developed. Most of the trees and other vegetation have been strategically placed to landscape the roadway and structures politely. Air conditioning has effectively neutralized the climate of the Central Florida (although some attractions require that they be located outdoors). Geographic location however, is important. This tourist landscape owes its development and growth almost entirely to its proximity to the Walt Disney Complex.

The Axiom of Cultural Unity and Landscape Equality, The Axiom of Common Things, and the Axiom of Landscape Obscurity. With this last group of axioms, Lewis tries to emphasize to us that landscape reading and interpretation can be difficult at times. We must remember that all items in the landscape reflect culture in some way. Many objects, however, may not convey clearly their message about culture. Finally, common landscapes (such as those studied in this chapter) are the most difficult to interpret. This is because they contain very few (if any) unique or famous symbolic structures. With an ample amount of curiosity and perseverance, one can interpret even the most common landscapes.

Our examination of the landscapes of Kissimmee provides support for these axioms. For example, the increased revenues obtained by Kissimmee as a result of the tourism boom is apparent by the new police station, library, and civic center. This is also evident from a common component of the landscape, the new park benches and waste receptacles found along the sidewalks of Main Street. The importance of Walt Disney World in contributing to Kissimmee's economic and population growth is evident in another seemingly inconspicuous component of the landscape, small banners hung from the light poles of US-192. These banners portray Disney characters and proclaim "Thank You for a Magical 25 Years." Also recall that new street lighting has been installed on both Main Street and US-192. The differing styles demonstrate the distinctive atmosphere local leaders and planners attempt to create in each place: in the historic downtown of Kissimmee and the modern tourist landscape of US-192.

Conclusion

Each of the axioms that we have used in this chapter has demonstrated that the human made landscape does indeed provide us with clues to culture. It is important that we attempt to examine these individual clues collectively to determine whether we can also interpret some broader cultural messages. We seem to have uncovered several general themes. For example, the landscape of US-192 demonstrates the importance (or necessity) of growth in our society. This landscape has been built to attract people (both visitors and residents). More people may in turn create more wealth, more jobs, more activities, more buildings. Growth can also result in unwanted effects such as more traffic, more noise, more pollution, more crime. It appears that here, growth is preferable to stagnation or decline. The landscape of Downtown Kissimmee demonstrates a desire to maintain an attachment to times past, when there was a slower pace and stronger sense of community. In fact, this landscape may be preserved and maintained to counteract the growth and change that occurs so rapidly on US-192. These are just the speculations of the author, and interpretation will vary from individual to individual.

Lewis (1979) devised his axioms to encourage geographers and others to increase their awareness of the human-made landscapes and the cultural messages they provide. He concluded that "looking at the landscape, reading the landscape, thinking, then looking and reading again, can yield remarkable results, if only to raise questions we had not raised before."

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4

Florida's Population in the 1990s: A Geographic Study

Edward Fernald

Florida has always been a growth state. Since the first census of the territory in 1830, population increases less than 30 percent have occurred in only two decades, 1910-1920 and 1930-1940. The 1950s showed the largest percentage increase at 78 percent, although the largest numerical increase occurred in the 1980s (Figure 4.1). Following the 1970 census, demographers nationally were surprised that a state which started with a base of 5 million people in 1960 had grown at the rate of 34.7 percent. They were more surprised when the 1980 census showed that, during the 1970s with a base population of 6.8 million, Florida grew over 42 percent. Compared with other states during the 1980s, only Nevada, Arizona, and Alaska had larger percentage increases than Florida, and only California had larger numerical growth. Florida was the only state to rank in the top five in both percentage and absolute increase during the 1980s.

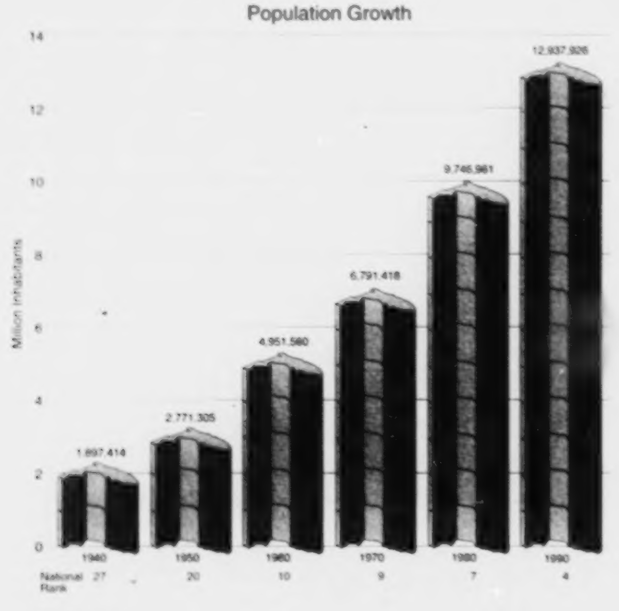


Figure 4.1

The 1980 population was 9.7 million. Population in April 1990 was 12.9 million, which made Florida the fourth most populous state behind California, New York, and Texas. The percentage increase between 1980 and 1990 was 32.7, which is 2.7 percent per year compared with 3.6 percent per year during the 1970s. Between 1990 and 1995, Florida's population grew by 1.2 million. In absolute numbers its growth was exceeded only by California and Texas. The estimated April 1, 1996, figure was 14.4 million. Between 1990 and 1996 Florida's population grew by 673 people per day. This growth is seen differently by different people. The salesperson or banker may see it as totally positive while others might share the feelings as shown by this cartoon from the Ft. Myers *News Press* (Figure 4.2).

Figure 4. 2: Florida Growth and Natural Resources
Reprinted with permission of the News-Press of Fort Myers

Why, historically, has this spectacular growth taken place? Several factors that have ignited growth can be identified for Florida.

- In general, military actions have had positive long-term effects on Florida's population growth. The Spanish-American War, World Wars I and II, Korea, Vietnam, and, to some extent, even the Seminole Wars and the Civil War strongly influenced population growth. Many of the military men who served in Florida during these wars later returned as tourists and finally as residents. More recently the Cuban Revolution and other social uprisings in the Caribbean and Middle America have brought immigrants to the nearest friendly soil, which happens to be Florida.
- Henry Flagler and Henry Plant ignited early growth. These gentlemen built railroads in Florida in the late 1800s, and in order to have people and products to use their railroads, they developed hotels, agriculture, forestry, and other economic activities. They were our earliest comprehensive planners.
- By the 1950s growth came from economic stability, social security, and labor gains in the North. Disposable income for vacations, assured retirement programs, and early retirement all contributed to Florida's growth.
- In the 1960s, the space program and the associated expansion of electronics industries fueled much of Florida's growth.
- Interestingly enough, both economic booms and busts in the national economy have motivated people to move to Florida. When people had extra money they vacationed here and when they felt strapped financially they came because, rightly or wrongly, they felt it is less expensive to live in Florida.
- Over the years improvements in transportation and other technology, such as air conditioning and critter control, as well as publicity campaigns, have had positive effects on growth.
- Since the 1960s billions of dollars have been invested by Disney, Universal, Busch, and others and the 100s of millions of dollars by the private and public sectors to build infrastructure to support the tourism industry.
- Our relative location to ocean lanes and the Panama Canal, which is directly south of Florida, and Latin America have made Florida the major tourist and shopping destination for Latin Americans and is making Miami into the Hong Kong of the Western Hemisphere (Figure 4.3).
- Finally, the low cost of a high quality of life has attracted people. We benefit economically from homestead exemptions, no income or inheritance taxes, and the relatively low total tax burden yet enjoy the attractive physical environment of the Sunshine State.

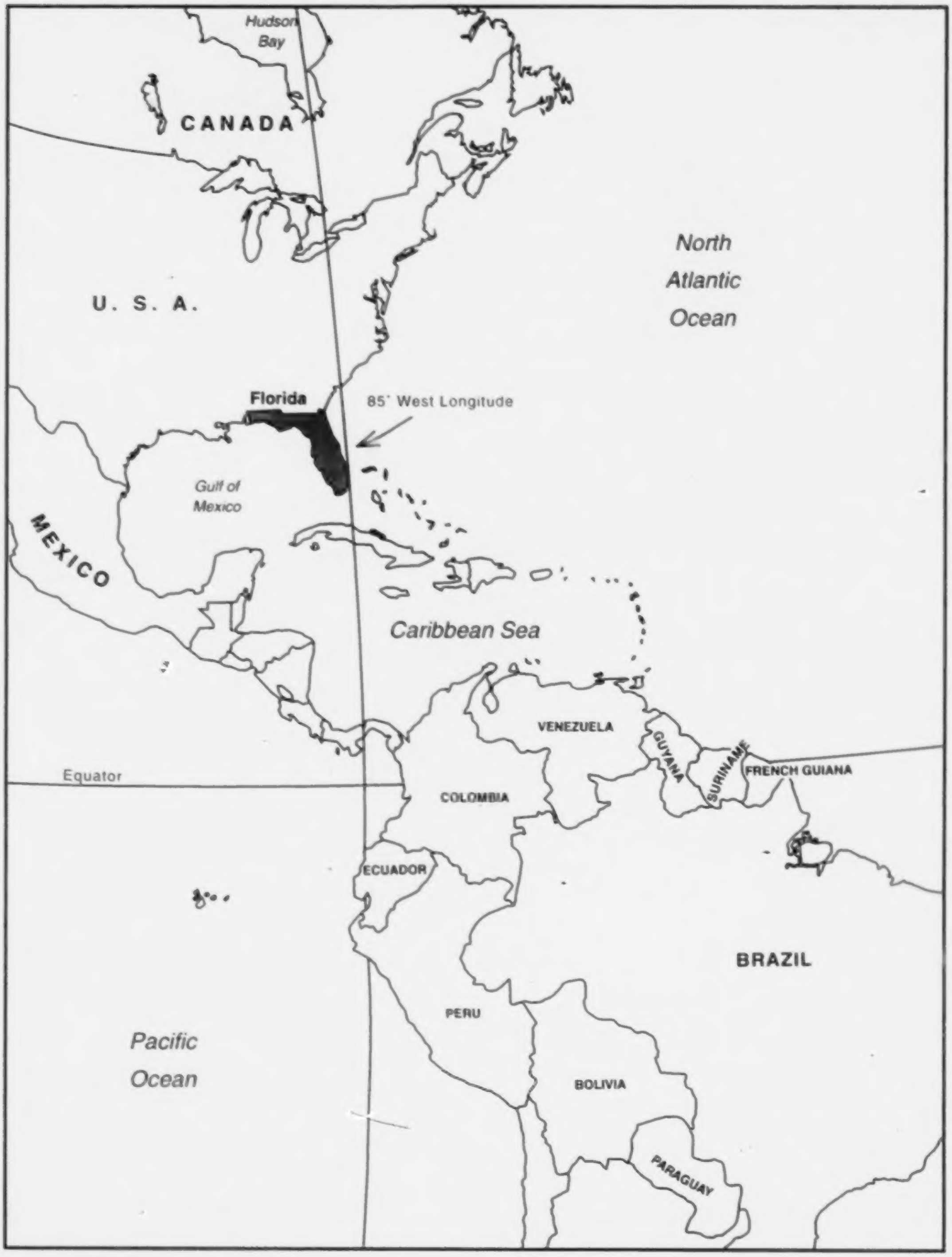


Figure 4.3: Longitudinal location of Florida relative to Latin America

Aspects of Population Growth

Geographers and demographers look at two aspects of population growth: natural increase and net migration. *Natural increase* is the number of births minus the number of deaths, and *net migration* is the difference between the number of people moving into the state and the number of people moving out. In Florida, natural increase between 1980 and 1985 accounted for only 11 percent of Florida's growth. Although this figure increased to 22 percent between 1990 and 1995, net migration continues to account for most of Florida's growth. This is because of: (1) the age characteristics of Florida's population, (2) the high cost of raising children, (3) the economic need for a two-person income in a family, and (4) the professional goals of women. In 1980, we felt that the natural increase would become negative sometime during the mid-1980s. This did not happen. However, on the Sun Coast in 1995, each county from Charlotte to Citrus with the exception of Hillsborough had a negative percent natural increase, meaning that there were more deaths than births. Yet, every county grew because of net migration.

A pattern of migration to and from Florida is seen on Figure 4.4. People from the northeast United States tend to locate in southeast Florida while midwesterners tend to vacation and reside on the southern Gulf coast. Newcomers from the southeastern United States tend to go to the Atlantic coast from Daytona Beach north or to the northern Gulf coast from Panama City west. These patterns have been constant for forty years.

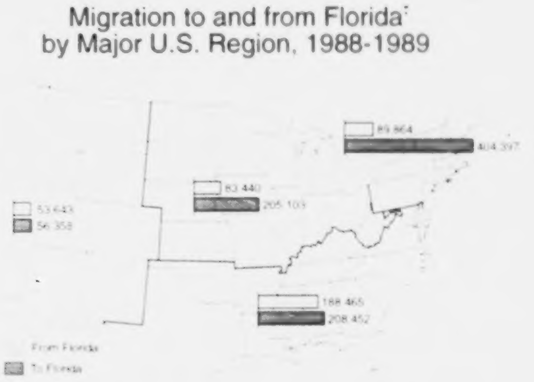


Figure 4.4: Migration to and from Florida by Major U.S. Region, 1988-1989

A look at the population distribution map (Figure 4.5) may cause one to wonder why a growing population should be considered a problem when so much of the state is uninhabited. Florida's population distribution is explained, in part, by the simple geographic generalization that people tend to live where they can make a living. The population supporting potential of much of Florida's empty land is close to zero. Large parts of the state are too wet or are overly drained sandy pine flatwoods and scrub areas. Other factors leading to empty acres are: large land ownerships and distance from urban services.

Factors of Areal Distribution

Dot maps can help us analyze the areal distribution of Florida's population by showing density, dispersion, and patterns. Density, a function of area and total population, is for most uses more helpful to consider than just a numerical total. Density indicates the population supporting potential of an area as influenced by the people's level of technology. It also suggests the pressure of people and their culture on natural systems. Population density in Florida, which statewide in 1996 was 270 persons per square mile, ranged from 8 persons per square mile in Liberty County to more than 3,129 in Pinellas County. Such a high density exerts tremendous pressure on land and water supplies, social services, utilities, and transportation. Density pressures on land have policy implications for the protection not only of environmentally fragile areas, but of water and agricultural land, which are important resources to Florida's economy.

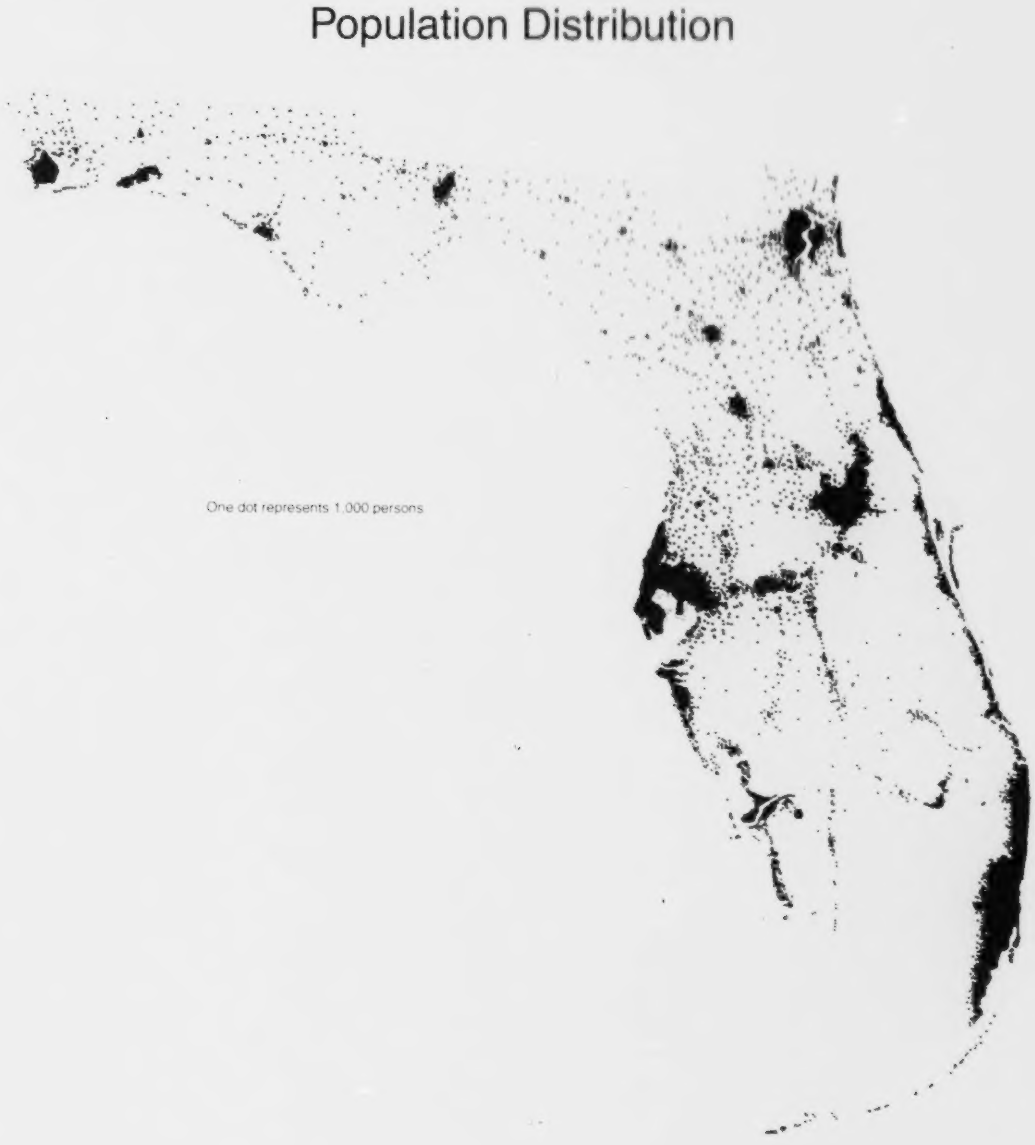


Figure 4.5: Population Distribution in Florida

Historically, people first occupied St. Augustine, Pensacola, and Key West for strategic purposes. From 1850 until sometime during the 1890s, Key West was the state's largest city. In the colonial period the Spanish wished to connect their port holdings in St. Augustine and Pensacola with Indian missions across north Florida, while later railroads and roads influenced new settlers to settle southwest along the coasts. As shown, the unique settlement was strategically located at Key West. Over time, people moved to Jacksonville, Tampa, and Miami because of port activities and coastal amenities and to agricultural service centers such as Lakeland, Orlando, and Lake City. As we know, because of changes in economic trends, the functions of some of these cities have either changed or broadened. A simple generalization from geography is that people live where they can make a living. Today, however, many people live on barrier islands to enjoy the sun, sea, and sand. Some environmentalists and planners would say this is a poor place to live because of a lack of water, dune destruction, and coastal erosion. In today's mobile society much economic activity can be located where people want to live, and bridges and relatively high-speed roads allow people to commute longer distances to work. Many older Floridians are able to live on the fragile coast because they make their living by going to the mail box for a retirement and a dividend check.

The next figure (4. 6) shows population growth by counties between 1980 and 1990. We see that counties with the highest growth rates are on the southern Gulf coast, an area where rapid growth started in the 1960s and is now beginning to slow, or counties that are satellites to major urban centers such as Hernando, Citrus, St. Johns, Flagler, or Martin counties. People move to the satellite counties to get away from the crowding, to enjoy a lower cost of land, lower taxes, and amenities, such as a larger lot or a kitchen garden. Of course, as the population increases in those counties, people begin to lose the benefits they went there to achieve. An interesting case that began as a satellite county is Broward County (Fort Lauderdale), which in the 1930s when compared to adjacent Dade, was quite small but began to grow rapidly. By 1970 Broward County had a population of 620,000 and grew 64 percent to just more than a million people by 1980. That numerical increase during that decade in Broward County was larger than that of the individual increase of 24 separate states.

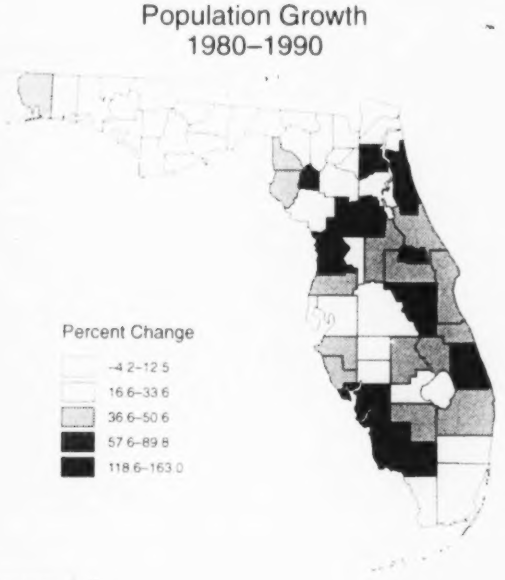


Figure 4.6

Figure 4.7 provides another geographic technique for looking at areal distribution. Patterns can help us make some useful observations. Although there are definite population nodes or centers, these centers coalesce into a ribbon or linear pattern of development along the high-energy coasts and the I-4 corridor. Seventy-six percent of Florida's population lives in coastal counties. Trends indicate a continuation of this pattern. High-energy coasts have a sea bottom gradient that allows wave energy to modify the land and create white sandy beaches and barrier islands. A low-energy coast has shallow water for many miles off shore that dissipates the wave energy and creates a muddier bottom than along the high-energy coasts. These are not as attractive to tourists but attract hunters, campers, and fishermen. Low-energy coasts are also a valuable marine nursery environment.

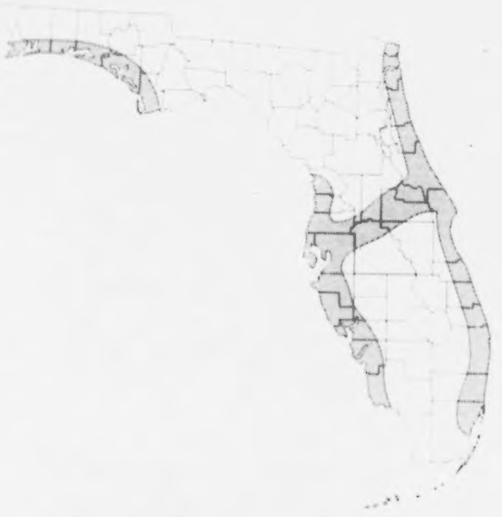


Figure 4.7: Pattern of Population Distribution in Florida

More than 80 percent of Florida's citizens live in urban areas. The urban increase has resulted not only from immigration from other states and nations but also, beginning in the 1930s, from movement of people from farms to cities. This movement has put pressure on land use, infrastructure, welfare systems, low-cost housing, recreation programs, and schools and has caused frustration because of the increased competition for unskilled, low-paying jobs. This situation, however, and the integration efforts of the 1960s, has caused some upper income people to begin the reverse move into high-value, planned communities away from the urbanized core. This suburban dispersion has resulted in a shift of retail businesses from central business districts to outlying malls and, in turn, has caused the demise of downtowns and fiscal problems for cities. The present lower cost of living and a more rural lifestyle in some northern counties are beginning to attract not only migrants from out of state, but Floridians from southern counties. Some south Florida citizens move to north Florida because of their perception that it has too many people, too much crime, and high prices and their desire to benefit from the slower pace and old South atmosphere of the north Florida region. (Test the hypothesis: In Florida the farther North you go, the farther South you get.)

Age characteristics are of prime importance to policy makers in many areas of government, including labor, education, and other social service departments. Two ways to look at age characteristics are: the population pyramid or profile and the dependency load of a particular area. Though these data are from the 1990 Census the profiles will be the same in 1997. The population profile for Florida (Figure 4.8) shows the low birth rate in the state, *the large number of baby-boomers who are now 30 to 50*, and the large number of individuals over 65. The profile is not entirely unhealthy: compared with that of the U.S. as a whole (Figure 4.9), the U.S. has a higher percentage in the baby-boom cohort whereas Florida has more people over 55. The Dade profile (Figure 4.10) again shows the lower birth rate but a more healthy number of people in the productive ages, between 15 and 65. The very large number of people in the over-sixty age group is softened because of the large population base in Dade County.

Pinellas, on the other hand, presents an interesting profile that, on the face of it, is not very healthy (Figure 4.11). The first thing that gets our attention is the very low number of young people and the relatively high number of people over 65. The baby boom bulge does show up, but the relative percentage of people at a productive age is quite low. We need, however, to realize that many of the people in the over-60 bulge are quite economically well-to-do. These people do not fit the non-productive description because so many in Pinellas have high income in retirement plans, dividend checks, etc. A number of other counties like Pasco, Hernando, Charlotte, (Figure 4.12) and Citrus have fewer young people and a high percentage of elderly, but they have a much lower per capita income. Pinellas, Sarasota, and Palm Beach are in the $25,000-$35,000 per capita income range, while Pasco, Hernando, and Citrus are in the $16,000 category.

Orange County does not display a typical Florida profile. It shows a relatively low birth rate but a very large bulge from age 20 to 44 or so that is caused by immigration of young people who seek jobs in the entertainment and tourist economy (Figure 4.13).

Leon County (Figure 4.14) appears to have an unusual age distribution until we realize that the large group from 15 to 35 is because of the presence of two universities, a junior college, and the state government that employs a large number of young people. The larger percentage of very young people shows a higher birth rate here than most counties and the lower percentage of people in the elderly age groups indicates that the retirement group has not found Leon County as yet.

Suwannee County (Figure 4.15) is typical of an agricultural county in which the birth rate is high, but the number of people in the productive age group is low because at about 20 years of age many people leave home for educational or economic reasons and do not return. The large number of young males in Union County (Figure 4.16) does not suggest that here is the place to send your unwed daughter. This shape is explained by the fact that a large state prison is located in the county and its inmates are counted as part of the county's population.

Another way to look at population is a dependency ratio or dependency load (Figure 4.17). Those counties such as Dade, Brevard, and Escambia with more than 60 percent in the productive age group are very healthy, whereas the counties of Manatee, Charlotte, and Suwannee are less healthy. Again, Union County is an exception to this rule as the prison inmates account for a large portion of the 71 percent of the county population in the "productive ages."

During the 1970s, the 65 and older group in Florida grew by 71 percent, nearly twice the rate as the rest of the population. In the 1980s, this rate of growth was 40.4 percent. Florida is now, with 18.7 percent of its population 65 and older, the *oldest state* in the nation.

Florida counties with the highest percentage of older people are on the Gulf coast, whereas the counties with the largest numbers of older people are Dade, Broward, and Palm Beach on the Atlantic coast. Florida has thirteen counties in which more than a quarter of the population is age 65 and above. In 1995, Charlotte County had 34 percent of its population over 65; Sarasota, 32.8 percent; and Manatee, 27.8 percent. Pinellas is twelfth at 25.5 percent. Older people tend to be less progressive, more resistant to change, and more apt to vote down bond issues for education or other public projects. A number of policy questions are raised when we look at this age characteristic of our population. These policies need to be addressed, in part, because as the number of older people increases, their political power increases. They are conservative, but on the other hand, they often require a great deal of governmental services. They, like members of other age groups, require education, health, protection, and recreation, but their requirements take a different character than those of other groups. A problem in some Gulf coast counties is that the elderly compete with the unskilled and with teenagers for minimum wage jobs. The Governor's Department on Aging will help us better understand this age group. The legislature might also consider strengthening the Local Government Planning Act by requiring a demographic or social planning element in the local plans.

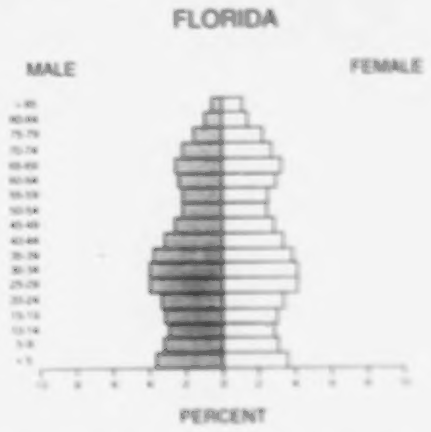


Figure 4.8: Population Profile of Florida

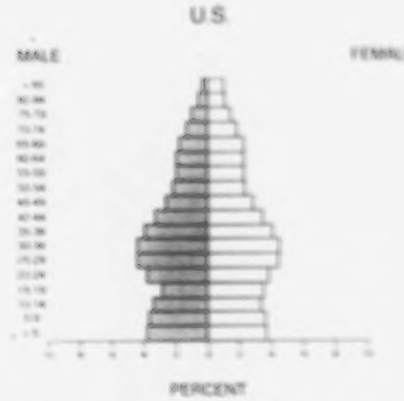


Figure 4.9: Population Profile of the United States

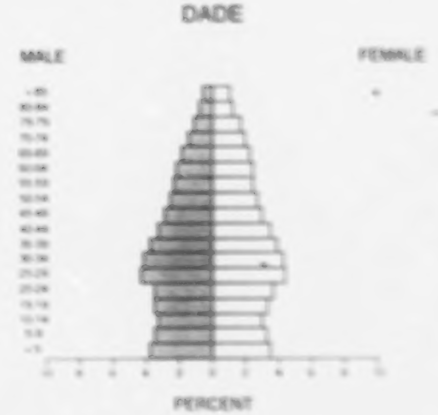


Figure 4.10: Population Profile of Dade County

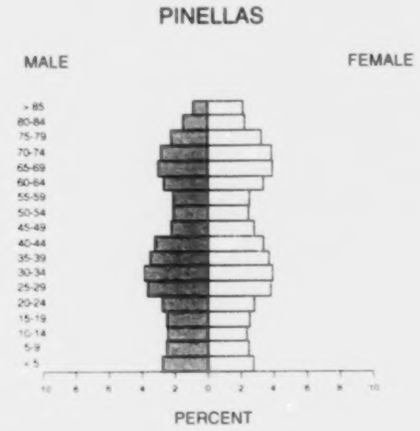


Figure 4.11: Population Profile of Pinellas County

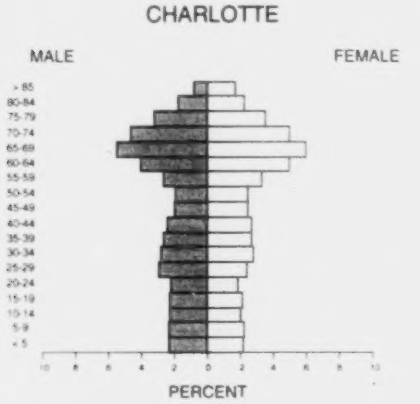


Figure 4.12: Population Profile of Charlotte County

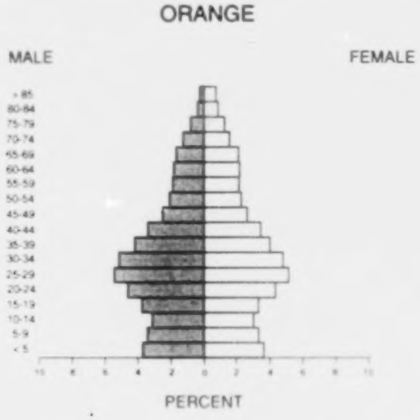


Figure 4.13: Population Profile of Orange County

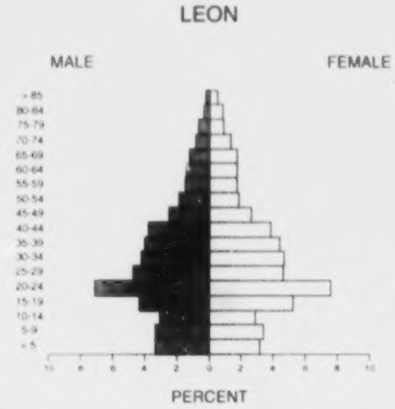


Figure 4.14: Population Profile of Leon County

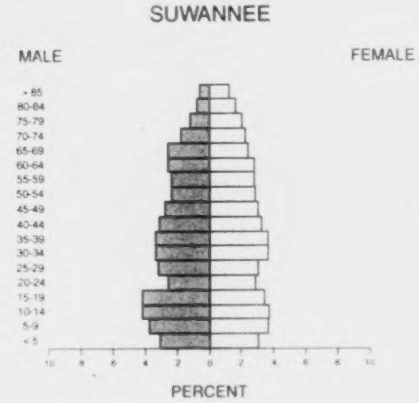


Figure 4.15: Population Profile of Suwannee County

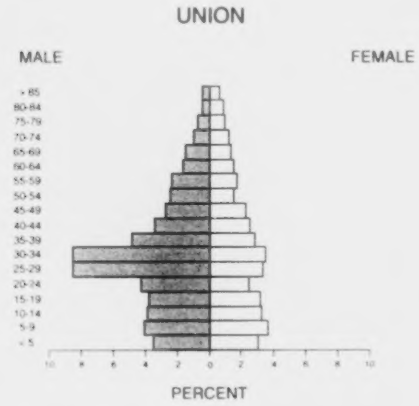


Figure 4.16: Population Profile of Union County

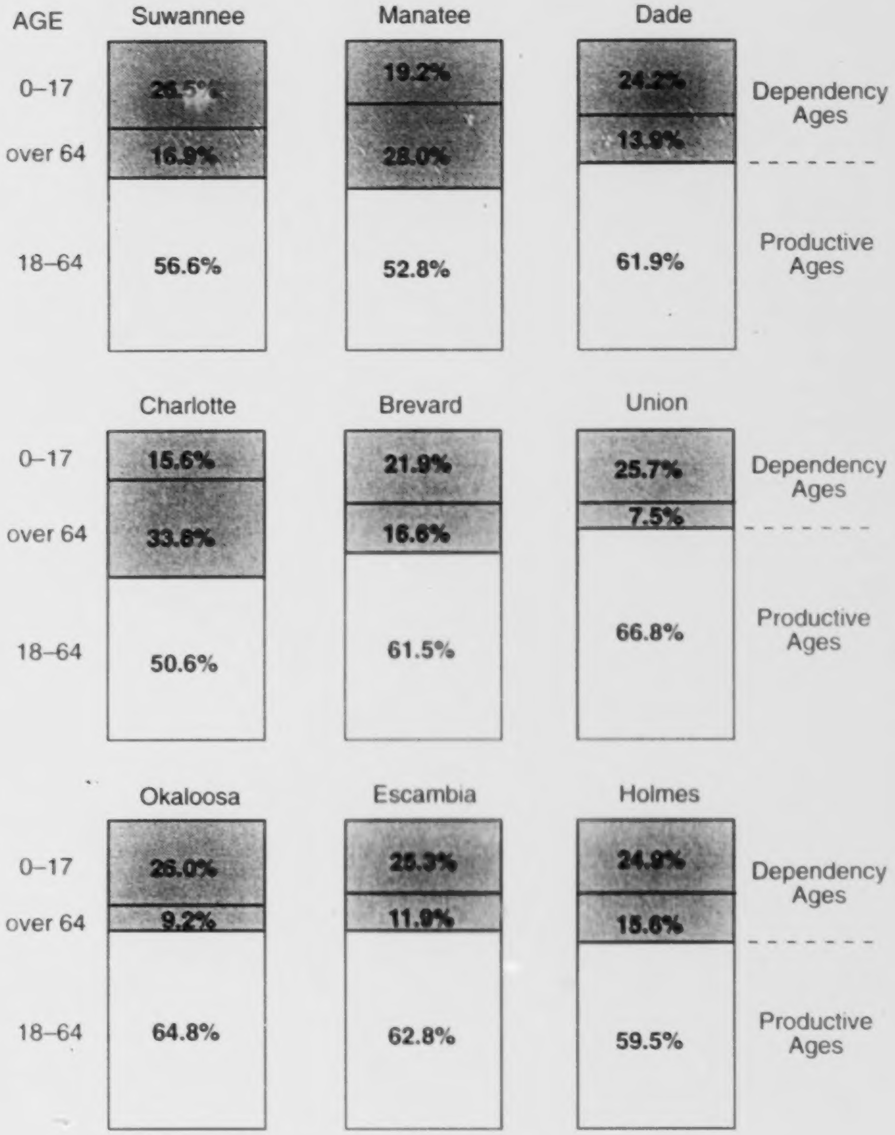


Figure 4.17: Dependency Loads in Selected Florida Counties

Twenty years ago John Naisbett indicated that Florida was a bellwether state in several areas, one of which is the age-youth ratio. He indicated that by the year 2010, the entire U.S. population will have the same age-youth ratio that Florida had then, and by carefully watching what happened in Florida, the country will learn a great deal about the problems and opportunities the whole nation will face in the future.

Several other characteristics of Florida's population warrant attention. Causes of death in Florida have historically been heart disease, stroke, cancer, and respiratory disease, as well as accidents. These data do not indicate that Florida is an unhealthy state. The rates of all but the last of these are heavily influenced by our large older population. Most of these people have not contracted these diseases in Florida, but have brought their cancers and respiratory ailments to Florida from other states. In general, Florida has an advanced health care delivery system. In terms of education Florida is ahead of other states on the basis of per capita years of schooling. Other states, however, have borne much of the expense of this favorable statistic. State statistics show that approximately 12.5 percent of our population is living in poverty. Florida's marriage rate is a bit higher than the nation as a whole and nearly half of all Florida marriages are remarriages. Florida's divorce rate is more than 30 percent higher than that of the U.S. as a whole. Data on ethnic groups show that the percentage of blacks in Florida has fallen from 40 percent in 1900 to 14 percent in 1995, whereas the percentage of Hispanics has increased from 5 percent in 1950 to 14 percent in 1995. Of more importance is the localized character of this trend. For example, the Dade County population was 56 percent Hispanic in 1995.

Forecasts and Problems

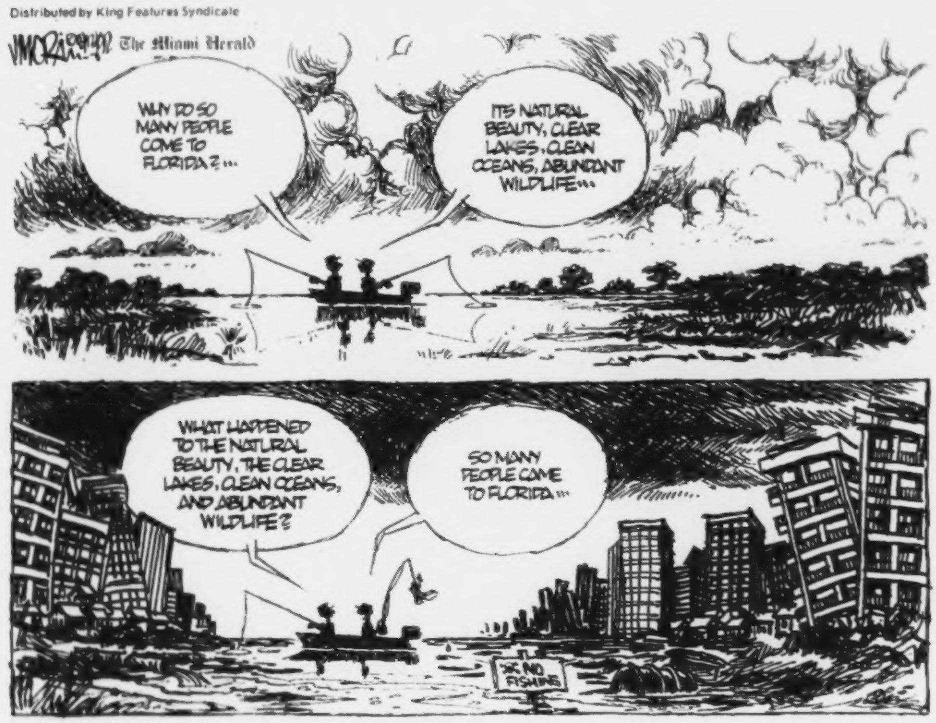
In the future, Florida's population will continue to increase at a rapid rate, although not as rapidly as it did during the 1970s and 1980s. Demographers have projected a population of more than 15 million by the year 2000. A growth rate of less than half that of the last decade will push Florida over 15 million. Expectations are that the only difference in the age, sex, or ethnic mix will be slight increases in the over 60 age cohort and an increase in the Hispanic percentage.

We should consider several generalizations from geography when we evaluate Florida's population growth. One, the physical environment suggests and limits human activities but does not dictate them. The physical environment would suggest 1) "Florida summers are too hot" or 2) "don't concentrate growth in coastal areas." These suggestions are overcome by technology. This leads to the next generalization which is that the effects of "the physical environment are a function of people's attitudes, objectives, and technical skills." Florida's wetlands, fragile coast, including estuaries, barrier islands, and dunes, suggest that few people, if any, live there. Nevertheless, people have chosen to live in the coastal region where wetland modification, dune destruction and erosion, and potable water problems are just some of the challenges with which we must be willing to deal, by the application of technology or through growth management, including selective preservation and fiscal appropriations at the local or state level. When humans modify the physical environment, they must pay an economic price to replace its natural functions or suffer a decrease in the quality or loss of the environmental service. An important need is to be able to identify the thresholds beyond which human occupance is too costly. A new breed of environmental economists is now specializing in developing formulae for calculating these thresholds. We need to know more about the costs of growth. As more people are added to a given area, even assuming a steady level of technology, more rules are needed to maintain social order. This suggests more, not less, government, although the form may change.

Florida's leaders have shown that they know the importance of population planning, but because of the inevitability of unforeseen events we must be skeptical of trend lines and build into our plans an ability to cope with crises we cannot control. We are aware that national economic health, immigration laws, weather patterns, and even the nation's foreign policy produce long-and short-term effects on Florida's population over which the state has little control. For example, a social or political uprising in the Caribbean is apt to create another unplanned influx of people. Haiti is a more recent example. A change in our federal policy toward Cuba could also seriously affect south Florida's population, as could migration and economic policies associated with an energetic federal Caribbean initiative. In very few, if any, other places in the world do we find a sharper division between wealth and poverty in such a short distance as we find between Florida and our Caribbean neighbors.

Several places in this chapter mention the dynamic character of Florida's population. We benefit from the skills, new ideas, and energy from Hispanics, from tourists, and new citizens from other states, but we also need to realize that most of Florida's citizens lack a common history and unifying background. This diversity tends to work against state pride and unity and can foster prejudices and regionalism, each of which makes it more difficult for elected officials to make rational decisions for the good of the whole.

A final policy problem concerning population trends and characteristics is to account for the *de facto population* in contrast to the formal census population. In Florida it is important to note the number of tourists that occupy an area at a given time—to understand what their ages, economic status, means of travel, and other characteristics imply for the state. This tourist population provides Florida with the highest per capita retail sales in the country. By 1995 more than 40 million people visited, spent more than $32 billion, and left. While they are here, they make a heavy demands on recreation, transportation, utilities, and housing resources. This demand is seasonal and the situation presents policy problems that cannot be addressed by yearly data or by data that are not site and time specific. It is estimated that Broward County has an additional 350,000 people during the peak tourist weeks. It is also reasonable to assume that winter-long visitors have different needs than two-week tourists. State and local agencies need to know more about different tourist groups.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The Miami Herald
WHY DO SO MANY PEOPLE COME TO FLORIDA?...
ITS NATURAL BEAUTY, CLEAR LAKES, CLEAN OCEANS, ABUNDANT WILDLIFE...
WHAT HAPPENED TO THE NATURAL BEAUTY, THE CLEAR LAKES, CLEAN OCEANS, AND ABUNDANT WILDLIFE?
SO MANY PEOPLE COME TO FLORIDA...
NO FISHING

Figure 4. 18: Why Do So many People Come to Florida
Reprinted with permission of the *Miami Herald* and King Features Syndicate

Geographers and geography students, using spatial analysis can describe and analyze the human population of a place. Through a lesson or unit on the population of your state students of all ages can be encouraged to look at not just numbers, but to meet the challenge of one-fourth of the National Geography Standards (1, 9, 12, 17, and 18) in *Geography for Life*. This is a geography study because it has us mapping and analyzing patterns, densities, diffusion, and dispersion of phenomena in place; by studying the relationships of physical and cultural phenomena within place and by understanding the spatial interaction of places. Geography helps us appreciate Jim Morin's cartoon in the *Miami Herald* (Figure 4.18).

Reference

Geography for Life: National Geography Standards 1994. Washington, D.C.: National Geographic Research and Exploration on behalf of the American Geographical Society (AGS), Association of American Geographers (AAG), National Council for Geographic Education (NCGE), and National Geographic Society (NGS). (Available from NCGE, Leonard 16A, Indiana University of Pennsylvania, Indiana, PA 15705-1087 for $7.00 per copy.)

5

Transportation and Development in Central Florida: The Rise of Orlando in the Transport Hierarchy

Russell Ivy, Michelle Falasz, and Pedro Palimino

Transportation plays a crucial role in the location and development of economic activity. Early transportation network development models discussed by Taaffe, Gauthier and O'Kelly (1996) as well as Lowe and Moryadas (1975) help to illustrate the important relationship between the two. These bodies of work clearly show that the most accessible places in a region are associated with a relatively higher level of economic buildup than those places disadvantaged by either the imposed transport network (such as being bypassed by the U.S Interstate highway system), or the lack of transport infrastructure altogether. This relationship between transportation and economic development is often considered to be a chicken-and-egg problem. In other words, does the creation of transportation arteries become an important stimulus for the attraction of economic activity, or does the presence of a potentially exploitable economic resource or comparative advantage (such as mining, agriculture, or even tourism) generate demand for the buildup of a transportation network? As discussed by Lowe and Moryadas (1975), "Gauthier (1970: 619) concludes that our knowledge of spatial economic growth does not clearly suggest the temporal sequence and relative importance among the transportation network, the differentiation of the subregional economic systems, the spatial structure of the urban hierarchy, and overall regional economic development." Various case studies conducted in different geographic regions and looking at the networks of different transport modes such as highway and rail (Lowe and Moryadas 1975) as well as air transport (Ivy *et al.* 1995) show support for both sides of the debate. At any rate, improved transport accessibility (transferability) increases the likelihood of spatial interaction between places, thus paving the way for growth and development, and this topic remains one of the important research agendas in transportation geography in the 1990s (Knowles 1993).

Concentrated population settlement and the creation of an integrated economic base came quite late to Florida compared to the rest of the eastern seaboard. The eventual introduction of state-wide transport systems allowed for the growth and connection of Florida's sporadic pockets of population. Improved transportation routes act both as an attraction, drawing more people and goods into a region, as well as a path for export, allowing interchange with other regional, state, and national centers. This chapter discusses the role that transportation has played in the growth and development of Florida with a particular focus on the central Florida region, which has an economy strongly focused on tourism and other services as well as the high technology enterprises associated with the military-space complex in the area (Malecki 1996). It is tourism in particular, as highlighted by various theories on tourism development (Pearce 1989) and related regional case studies (Gunn 1994), in which transportation networks are one of the most vital pieces of infrastructure necessary for successful planning and development.

The first section of the chapter looks at Florida transport development in an historical context, by discussing the creation of the early railroad network of the state and the resulting economic and demographic effects. The initial focus will be placed on the well-known Flagler railroad of Florida's east coast, eventually shifting to railroad development in central Florida. The discussion will also include the role of the Orlando area in the recently proposed high-speed rail system for the state of Florida.

The current position of central Florida in the transport hierarchy of the state is largely illustrated first with a brief examination of the major highway arteries that have developed, followed by a more detailed look at Florida's airports. According to the *Florida Visitor Study* (1995), air and highway travel make up the greatest proportion of the state's visitor population. In calendar year 1995, an estimated 19,764,218 visitors to Florida used the state's major highways (a growth rate of 6.7 percent over the previous year), whereas an estimated 21,518,096 entered the state via scheduled commercial air service (a growth rate of 0.7 percent over the previous year). The Orlando/Walt Disney World area was the main destination for both categories of visitors. As Orlando has become an increasingly important destination for travelers from greater distances, an improvement in the air transport connectivity of Orlando's airport has occurred along with the growing economic prominence of the central Florida region. In fact, the Orlando airport now draws passengers from a much larger service area (both coming into the state and exiting the state) than previously inbound to or outbound from central and north central Florida, luring passenger traffic away from other area airports (Ivy 1991).

Early Railroad Development in Florida

Comparable to the western fringes of the U.S., the introduction of the railroads was the impetus for the sustained attraction of people and economic activity throughout the state of Florida. As late as 1876, transportation networks south of Jacksonville were poorly developed, with only two cross-state railroads in operation (Akin 1992). The Florida Railroad, which linked Fernandina (north of Jacksonville) with Cedar Key (north of Tampa), and another route linking Jacksonville with Tallahassee, were the dominant long-haul transport connections for the movement of goods and people within Florida. After 1876, politicians used millions of acres of public land in the state to entice developers, particularly railroad builders, to link the more sparsely settled areas (Akin 1992; Martin 1949). The resulting attraction of entrepreneurs, most prominently Henry Flagler, was a key turning point in the transport and economic development of Florida. Even though the focus of this chapter is on the central Florida region, it is important to discuss the widespread influences that Flagler's railroad had on the state.

The Flagler Railroad

Flagler first arrived in Florida in 1878, and was largely responsible for building up the eastern fringes of the state from St. Augustine south to Key West with the completion of the first land transport link along the east coast (Figure 5.1). By 1889, he had constructed the Ponce de Leon Hotel in St. Augustine, and had merged and expanded the former St. Johns and Halifax River Railways to create the East Coast Line Railway. The improved infrastructure saw St. Augustine grow to become Florida's first resort town.

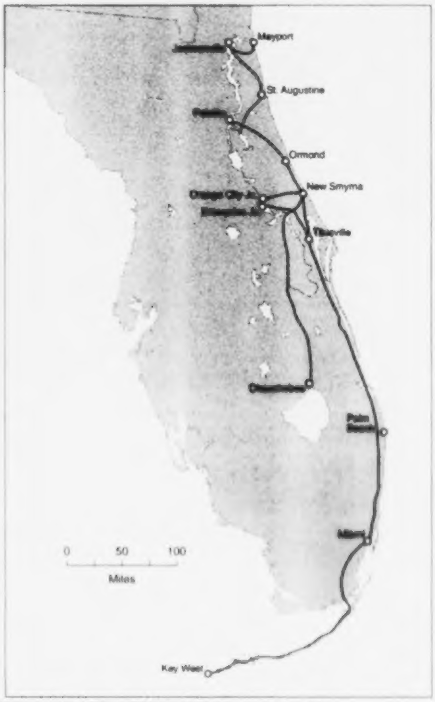

Figure 5.1: The Flagler Railroad, 1915

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Eventually, Flagler shifted his attention further south, extending his railway to Palm Beach. This created heightened growth to the region with additional hotels (including Flagler's Royal Poinciana, which opened in 1894) as well as other support businesses, and of course, more people. The creation of West Palm Beach, for example, largely grew out of the demand for residential space for workers in the hotels, businesses, and posh residences of the newly-founded resort community.

Even though Mr. Flagler had intended on terminating his railway at Palm Beach, a harsh winter in 1894-1895 prompted the entrepreneur to push further south in search of a true year-round warm climate (Akin 1992, Martin 1949). The East Coast Line Railway was renamed the Florida East Coast Railway with its extension to Miami, and finally to Key West by 1912. This was the most extensive transport artery in the entire state and was an important impetus to the development of the east coast of Florida.

The extension from Miami to Key West took nearly nine years to build, and required hundreds of workers, many of whom brought their families with them and settled in the Miami area. Key West had already been an important city within Florida's urban hierarchy (particularly as a port and naval base) before Flagler's arrival, but Miami did not begin to thrive economically until the transport link with Key West was complete. Soon Miami became an official port of entry for the U.S., and began to flourish as a link between Key West, the Caribbean and beyond.

Railroad Development in Central Florida

The connection between railroad transport and population and economic development was evident in other regions of Florida as well. Railroad transportation was not well established in central Florida until 1880 when the South Florida Railroad was built connecting Sanford with Orlando. This 22-mile route was responsible for remarkable growth of population and economic activity in the area, particularly within the vicinity of Orlando (Figure 5.2). Prior to the railroad completion, passengers and freight were hauled from town to town by oxen-drawn carriages and carts. The new transport routes made it easier and quicker to move people and goods, particularly Orlando's citrus products, around the region (Gore 1957). With the further extension of the railroad to Kissimmee in 1883 and Tampa and its harbor in 1884, central Florida was now in a position to grow and prosper. As discussed by Gore (1957: 118), it was said that in 1880, Orlando which "was but a hamlet in the woods, now has fifty stores, seven churches, a seminary, opera house, five first class hotels, a machine shop, two carriage shops, an ice factory, four drug stores, three bakeries, two weekly papers, and several confectionery stores and restaurants." The population of Orlando grew from around 200 in May of 1880 to 4,000 in 1886 and topped 10,000 at the end of the decade (Gore 1957).

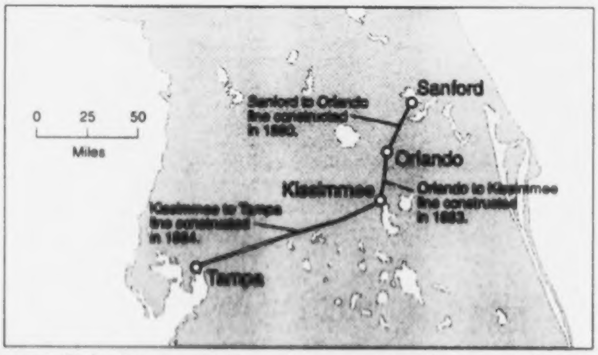
Sanford
Sanford to Orlando line constructed in 1880.
0 25 50
Miles
Orlando
Kissimmee
Orlando to Kissimmee line constructed in 1883.
Kissimmee to Tampa line constructed in 1884.
Tampa

Figure 5.2: Railroad Development in Central Florida

High-Speed Rail in Central Florida

The future may bring even greater rail accessibility to central Florida. What lies ahead for Florida's transportation development may be the Fastrain network (using magnetic levitation) proposed to run 150 miles per hour from Tampa to Miami via Orlando (Figure 5.3). The travel time from Miami to Orlando alone is estimated to be a mere 1 hour and 45 minutes. The first phase of the development is planned to schedule 16 round trips per day with stops at the Miami International Airport, Hialeah, Ft. Lauderdale, West Palm Beach, Orlando, Lakeland, and Tampa (Vranich 1991).

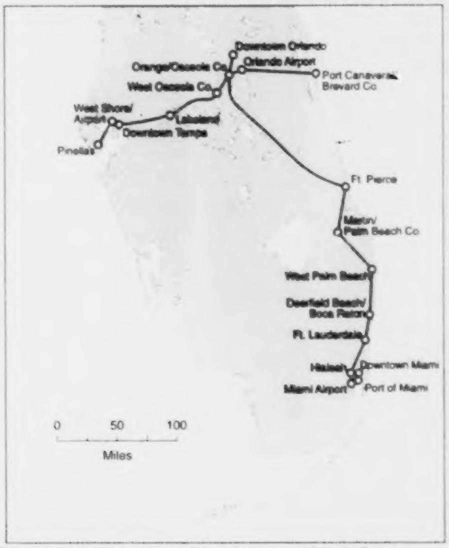

Figure 5.3: Proposed High-Speed Rail System

The Fastrain in Orlando is planned to operate out of the Orlando International Airport linking the facility with the tourist complex on International Drive, "where developers will build a Grand Central Station complete with a resort hotel" (Vranich 1991, 142). This new transportation system within the state will again place Orlando in a central position in Florida's transport network, particularly if politicians in other parts of Florida are able to convince the Florida High Speed Rail Corporation to extend the line to points farther north such as Gainesville, Tallahassee and Jacksonville.

The Highway Network of Florida

Because of the size and elongated shape of Florida, the development of an extensive highway network was vital to the growth and integration of the economy of the state. Connecting the main population centers in the northern part of Florida with the growing central and southern centers became a main focus, and indeed most of the traffic flow in the state has always been along the north to south transport arteries. Historically, US Highway 1 which stretches from Maine to Key West, and US 441 running north to south through the central part of Florida (eventually veering southeast) dominated the traffic volume totals for the state. As illustrated in Figure 5.4, Florida's current highway system is made up of five major routes: Interstate 10 (I-10), Interstate 95 (I-95), Interstate 75 (I-75), Florida's Turnpike, and Interstate 4 (I-4).

I-10, which runs east to west over a distance of about 362 miles through the northern panhandle, connects Jacksonville with the Pensacola area near the Alabama state line. Along with I-4, this route serves as one of the few major roadways that cuts across the entire width of the state.

I-95 follows the east coast communities from Jacksonville to Miami is one of the most heavily traveled corridors in the state. Tourists, seasonal residents, and business traffic alike take advantage of the 347 mile straight-shot routing that links all of Florida's Atlantic Coast communities with the eastern seaboard of the United States.

I-75, which serves much of the north central region and eventually the west coast of the state, stretches from the Georgia state line through Gainesville and Ocala into the Tampa Bay area, and southward to Bradenton, Sarasota, Fort Myers and Naples. From Naples, an eastward extending roadway known as Alligator Alley crosses the southern part of the peninsula to connect the southwest coast of Florida with Broward County.

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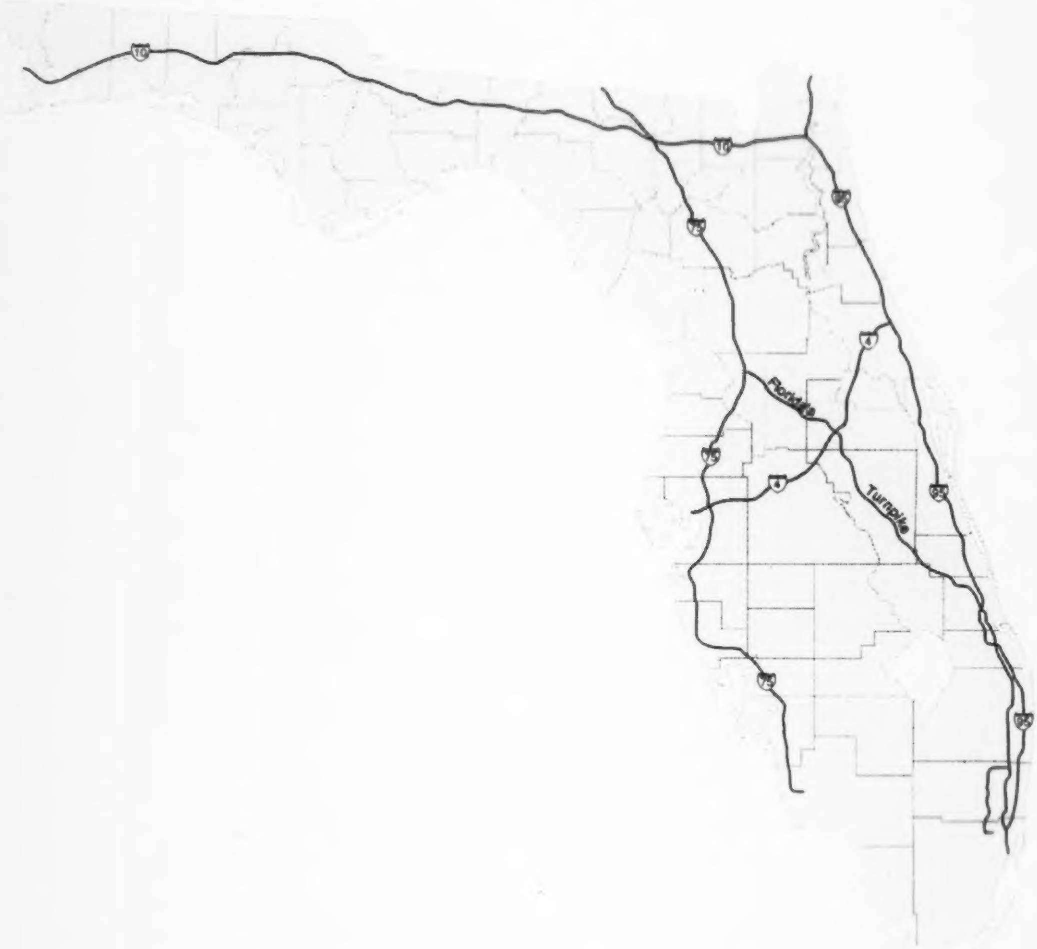

Figure 5.4: Major Highways

Florida's Turnpike is a 345-mile toll road stretching from just north of Orlando (Wildwood) to the south Miami area. The roadway, sometimes referred to as the Sunshine State Parkway, was begun in 1953 and completed in 1964.

I-4 is a vital link in the state transportation system for the Orlando area. The highway passes through Orlando connecting the Tampa Bay area with the east coast of the state near Daytona Beach. The roadway passes through 6 Florida counties (Hillsborough, Polk, Osceola, Orange, Seminole, and Volusia) over a distance of almost 132 miles.

As illustrated, Orlando is at the crossroads of the state, not just from sheer geographic or physical centrality within Florida, but also from the perspective of the accessibility of Orlando to the major Florida cities and attractions via the state highway system. The combination of the nearness of Florida's Turnpike, which carries the bulk of the traffic between central Florida and the crowded southeastern coast of the state, and the highly important east to west link, I-4, has elevated Orlando to the top of the highway transport hierarchy of Florida, truly occupying a crossroads position within the state.

The Growth of Air Transportation in Central Florida

Air passenger traffic growth both within and into the state of Florida has risen dramatically in the past 25 years responding to demand for the state's goods and services, as well as the rapid increase in the Florida population base. As central Florida has grown in economic prominence, the need has become more urgent to increase airline service, both in terms of flight frequency and nonstop connections, and to become more accessible within the national transport hierarchy. The deregulation of the U.S. airline industry at the end of the 1970s gave carriers the freedom to build networks as they desire, and many airlines have responded with an intense focus on service to Florida, some even to the point of building up hub status (airports used as important transfer or linkage points within an airline's network) particularly in Miami and Orlando (Ivy 1993b).

Since the opening of Walt Disney World in 1972, and various other tourist attractions and services in the central Florida region, the Orlando airport has become one of the fastest growing airports in the nation for the volume of passenger traffic. As illustrated in Table 5.1, domestic and international passenger growth at the Orlando Airport has risen rather steadily since the early 1970s. According to the *Florida Visitor Study* (1995), Orlando is second only to Miami in total airport activity for all airports within the state. A brief comparison of some of the state's major aviation facilities shows how each has performed through the previous two decades, indicating positional change within the state as well as the national air transport hierarchy.

Table 5.1
Domestic and International Enplaned Air Passenger Flow
at the Orlando International Airport

	Domestic	**International**
1971	635,911	0
1976	1,798,413	873
1981	2,896,576	99,133
1986	6,085,134	217,709
1991	8,135,372	979,247
1995	9,948,026	1,189,275

Source: *Airport Activity Statistics of Certified Route Air Carriers*. Annual. Washington, D.C.: Federal Aviation Administration, Department of Transportation.

The Orlando International Airport

The airport property, which includes an 854-acre site (346- ha) for the terminal complex, a 1400-acre (567-ha) air cargo park and 205 acres (83 ha) designated as a foreign trade zone, comprises about 23 square miles (67 sq km) in total, which ranks it among the largest airports in the U.S. in area (Greater Orlando Aviation Authority, 1996). Under the direction of the Greater Orlando Aviation Authority, created in 1975, the facility has attained international status and opened a new $300 million Terminal Complex in 1981, and the Phase II Capacity Improvement Program in 1988 which greatly enhanced the international service capabilities. Entering the current decade, the Orlando Airport ranked 17th within the U.S. and twenty-sixth worldwide in passenger traffic with an international traffic increase of 106 percent over the previous year (Greater Orlando Airport Authority, 1996). Between 1973 and 1993, total passenger volume increased by 659 percent, and the facility is currently the 6th busiest port of entry into the U.S. Ivy (1993b) classifies Orlando as a *destination hub*, indicating that the airport is linked with nonstop flights to many other airports across the nation, but few passengers are transferring to flights bound for other cities upon their arrival in Orlando. In other words, Orlando is usually the final destination for the passenger. This is in stark contrast to airports like the Charlotte Douglas International Airport in North Carolina, for example, which has a transfer traffic base of well over 50 percent as an important pivot city in US Airways (formerly USAir) transportation network (Ivy 1993b).

Comparison of Activity at Other Selected Florida Airports

A perusal of Table 5. 2 compares the performance of a selected set of five of Florida's larger airports from various parts of the state over the past twenty years. The data were collected from an annual publication of the Federal Aviation Administration (FAA), *Airport Activity Statistics of Certified Route Air Carriers*, which categorizes U.S. airports as large, medium, small or nonhubs based on passenger activity alone for the year in question. Note that the FAA definition of a hub (hereinafter referred to as an FAA hub) is not as specific as the airline definition mentioned above (which means a heavy buildup of flights from many different airports allowing for the transfer of passengers to many destinations). The airport facilities for Miami (MIA), Tampa (TPA) and Orlando (MCO) are currently classified as large FAA hubs, whereas Jacksonville (JAX) and West Palm Beach (PBI) are medium FAA hubs. Large FAA hubs have 1 percent or more of the total enplaned passengers at commercial airports, and for medium-sized FAA hubs the share ranges between 0.25 percent and 0.99 percent. The marked rate of growth of passengers at the Orlando airport dwarfs most of the other Florida facilities, and mirrors Orlando's climb within the economic hierarchy of the state.

Table 5.2
Comparison of Total Air Passenger Flow

	1973	1978	1983	1988	1993
JAX	1,980,037	1,781,037	2,254,145	2,714,636	2,856,482
MIA	14,978,994	16,344,259	19,321,718	24,525,302	28,660,396
MCO	2,828,931	5,182,264	8,030,350	16,479,262	21,466,033
TPA	4,848,645	6,984,037	8,228,049	9,719,976	10,018,233
PBI	327,526	2,397,078	3,930,842	5,013,517	5,074,132

Source: *Airport Activity Statistics of Certified Route Air Carriers*, Annual. Washington, D.C. Federal Aviation Administration, Department of Transportation.

Jacksonville International Airport (with no current international service), for example, experienced a 44 percent increase in air passenger traffic from 1973 to 1993, compared to a 91 percent increase for Miami, 251 percent increase for Tampa, and a 1,449 percent increase in passenger traffic at the West Palm Beach airport during the same time period. In the late 1980s, Orlando crossed the line of categorization from a medium-sized to a large FAA hub. Notice in 1988 and 1993 (Table 5. 2), Orlando has a larger passenger total than Tampa, and is gaining on Miami. Tables 5. 3 and 5. 4 illustrate the change within the airport hierarchy of Florida's main facilities by examining the share of air passengers and total aircraft departures at each. Notice that Orlando (as well as West Palm Beach) has grown in share of the Florida air passenger base whereas the remaining airports have declined. The period between 1983 and 1988 showed the greatest positive change for the central Florida airport, resulting in the overtaking Tampa as the second busiest airport for the state in the study set. Table 5. 4 examines the number of scheduled departures of commercial passenger aircraft over a 10-year time period and shows tremendous growth between 1983 and 1988 in which Orlando again takes over Tampa's second-place position within the airport structure of the selected study set cities in Florida.

Table 5.3
Share of Total Passenger Flow at Selected Florida Airports (in percent)

	1973	1978	1983	1988	1993
JAX	7.9	5.4	5.4	4.6	4.2
MIA	60.0	49.9	46.2	41.9	42.1
MCO	11.3	15.9	19.2	28.2	31.5
TPA	19.4	21.4	19.7	16.6	14.7
PBI	1.3	7.3	9.4	8.6	7.5

Source: Calculated from *Airport Activity Statistics of Certified Route Air Carriers*, Annual. Washington, D. C.: Federal Aviation Administration, Department of Transportation.

Table 5.4
Comparison of Scheduled Departures at Selected Airports

	1978	1983	1988
JAX	17,098	18,660	45,937
MIA	84,609	88,736	100,429
MCO	40,482	55,030	95,092
TPA	54,245	63,841	65,637
PBI	17,163	25,672	26,618

Source: *Airport Activity Statistics of Certified Route Air Carriers*, Annual. Washington, D.C.: Federal Aviation Administration, Department of Transportation.

The National Air Transport Hierarchy
Ivy (1993b) developed a ranking of air hub cities in the U.S. (airports designated by U.S. airlines as important transfer or pivot points within their respective networks) with respect to their direct (nonstop linkages) and indirect (multiple-stop linkages) to other major cities within the nation (i.e. domestic linkages only). This study includes Miami and Orlando (the only Florida airports thus designated by a carrier). Figure 5.5 shows the derived connectivity comparisons. As peripheral cities within the U.S. air transportation network, their importance pales in comparison to Chicago or Dallas, for example. Interesting, however, is a comparison of Orlando and Miami. In spite of Miami's higher traffic volume, the Orlando airport shows greater connectivity to the rest of the nation (recall that Ivy's study addressed domestic connectivity only). Miami's insignificant hub status is based on the fact that most of the transfer traffic and connectivity is on international flow largely to Latin America and Europe. As Orlando and the entire central Florida region has grown as a tourist, business, and high-tech (particularly the military-space industry) center, the need to be highly connected via air transportation within the national system is becoming more and more vital (Malecki 1996).

Conclusion
In the past 25 years, Orlando has experienced phenomenal growth in population, economic activity and position within the state and national transport hierarchy. The state highway system places Orlando at the crossroads of an integrated network, and the rapidly growing service to and from the Orlando International Airport has elevated the city's importance to the second busiest in the state after Miami, and from a domestic connectivity perspective, even beyond that of Miami. If the proposed high-speed rail network becomes a reality, Orlando seems likely to become an important focus on this routing as well. The growing transportation accessibility of Orlando (and the central Florida region) should continue to attract more tourists and business alike.

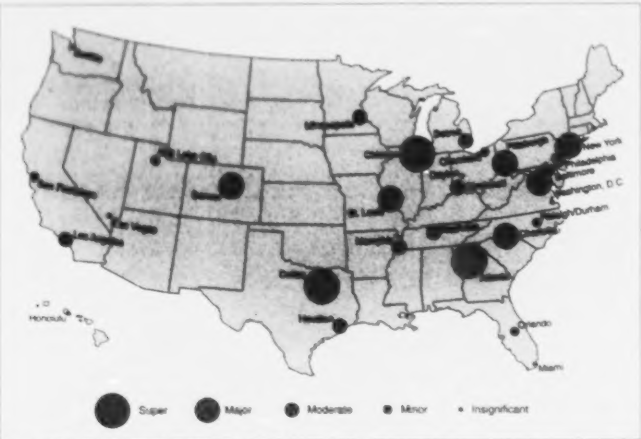

Figure 5.5: Connectivity Ranking of U.S. Hub Airports

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6

The High-Tech Economy of Central Florida: Genesis, Character, and Role of the Orlando Area Laser Industry

Eric M. Young

It is not uncommon to associate a place with the economic activity we perceive is occurring there. At the international level we have divided the world into such places as developing, developed, industrialized, newly industrializing, and third world. In the United States it is equally common to name places according to their economic characteristics; such as, Silicon Valley, the Rust Belt, the Motor City, the Space Coast. When we use these names and terms we feel that they not only describe the economic life of an area but also that they provide some clue as to the social and cultural life of the area as well.

As in the examples above, these terms are often either directly or indirectly associated with technology. The differences in technological capabilities between regions have become a central theme in contemporary economic geography. The ability of most regions to compete in the global economy is increasingly a function of their ability to keep pace technologically with other regions. As the importance of a region's technological capability to its economic health grows, we will increasingly associate its social and cultural characteristics with its technological capabilities as well. Florida is a perfect example of this phenomenon.

Although today it is safe to say that technology is not one of the first things to come to mind when thinking of Florida today, this may not be true in the near future. Tourism and agriculture form the bedrock of the Florida economy. From this foundation a great diversity of economic activity is developing. In addition to construction and real estate, a blossoming high-tech component in the Florida economy is beginning to gain the attention of scholars as well as local boosters throughout the state. This chapter examines the development of one of these sectors —optoelectronics—and explains its importance in the regional economy of central Florida.

Unmasking Central Florida's High-Tech Economy

Florida's reputation as a world-class tourist destination is well deserved. Indeed, the state's unrivaled beaches and other natural treasures together with ever popular amusement and theme parks are the foundation for a tourism industry that marks the state as one of the most popular tourist destinations in the world. This reputation as a place to have fun in the sun has also fueled a superficial perception of the state that has effectively masked an increasingly important component of the Florida economy: high-technology enterprises. Brevard County on Florida's Space Coast, and Orange County around what some in the Orlando area are now calling Laser Lane are two excellent examples of how this perception operates.

No greater symbol of technological prowess exists than space travel and exploration. For four decades the world has turned its eyes to Florida's Cape Canaveral to watch the United States launch its manned and unmanned missions into space. Today the launching and return of the space shuttle is reported over the local and national news with a sense of amazement and awe that has lasted since the very first forays into space. This sense of amazement and childlike excitement is a nearly spontaneous and uncontrollable emotion for most people. These emotions, however, tend to hamper our view of the truly astonishing facet of space travel: the scientific and engineering accomplishments of the thousands of employees at high-tech firms around the nation. As astonishing as space flight is, people appear to be equally astonished to learn that many of these high-tech firms are located along the Space Coast and in Central Florida around the metropolitan hub of Orlando.

This state of affairs should not be surprising. The prevailing image of Florida's role in the space program, as dispensed by television and print media, is simply as a launching and recovery site. The media's approach to events at Cape Canaveral serves to reinforce the image of Florida as the place where the fun part of life occurs, after the work has been done somewhere else. After all, the typical tourist works most of the year outside the state and travels to Florida to reap the earned reward for fifty weeks of work back home. As a major tourist destination, the Kennedy Space Center serves to reinforce this ironic image by providing the visitor with a sense of having another quality tourist experience but imparting little of the sense that Florida is home to some of the world's most technologically advanced companies employing thousands of capable scientists, engineers, and technicians.

Perhaps an even better example of the hidden technological prowess of the state is the growing cluster of optoelectronics firms in and around Orlando. The optoelectronics sector refers to any of those firms that combine the technologies of light (optics, or a relatively new term, photonics) and technologies of electricity (electronics) to produce a good or service. In general this sector includes companies ranging from communications companies that produce and use fiber-optic cable to companies that manufacture lasers. The Orlando optoelectronics sector is renown for its laser-producing firms. Upon hearing that the Orlando area is home to the third largest concentration of laser firms in the United States, behind Silicon Valley and Boston's Route 128, most people are somewhat dumbstruck. Orlando's claim to fame in the new global economy is its great theme parks and other tourist and convention amenities, that on an annual basis consistently rank Orlando as one of the most visited places anywhere on Earth. What few people outside the optoelectronics industry know is that the history of the laser is intimately linked with the Orlando area.

The laser has its roots in a rich tradition of science fiction and fantasy that reaches much deeper into history than the reality of the device itself. Death beams, ray guns and other such devices were fixtures in fictional literature for generations before the report in *Nature* by Theodore Maimon (1960) that he had achieved the first operating laser. It is with no small irony that Orlando, a place recognized worldwide for its efforts at bringing fantasy to life, has for more than three decades witnessed the evolution of a significant cluster of optoelectronics firms.

In recent years the growing number of these firms has drawn the attention of state and local economic development officials. In the eyes of many local boosters the optoelectronics sector represents a potentially significant contribution to the region's economy. The development of this idea has resulted in a vision of the Orlando area that most people would never associate with Central Florida. As Orlando's boosters tell the story, the current cluster of forty to fifty firms will act as a kind of seed that will grow into an agglomeration of firms that marks the region as a global center of laser research and manufacturing. With visions of Silicon Valley clearly occupying their concept of the future, local boosters have proudly coined the phrase "Laser Lane" to aid in the marketing of that future (Lundine 1995).

Central Florida's interest in developing its high-tech economy provides a keen example of an approach to regional and local development that more and more regions are pursuing. A closer look at the Orlando area's experience with encouraging high-tech development and its prospects for growing into a world-class center of high-tech activity could offer important insights for any region or locality that is considering a trip down the high-tech pike. The rest of this chapter will be presented in three parts. First, we will explore how the laser industry developed in Central Florida by examining its genesis in the area as well as the character the industry displayed as it expanded. Second, we will see how the character of the local industry and of the sector in general has contributed to the successful development of Central Florida's high-tech economic component. Finally, we will attempt to explain specifically why local boosters are so eager to see the optoelectronics industry expand by examining some local economic statistics.

The Birth and Expansion of Central Florida's Laser Industry

The laser industry came to Orlando in 1962 (10 years before Disney) when Martin Marietta (MM), now Lockheed-Martin, recognized a particular technological opportunity in lasers. Martin Marietta had established a research facility in Orlando in 1957 with the intent of developing the first guided or smart bomb. Orlando's proximity to the aerospace activities around Cape Canaveral and the city's growing urban amenities influenced MM's site location decision. When engineers at MM recognized that the laser was the key to developing functional and practical missile guidance systems, they immediately devoted considerable resources to the establishment of a laser research center in the Orlando facility.

Between 1965 and 1968 three engineers left MM to form their own laser firms. All three of these firms began operation primarily as subcontractors in MM's projects. Two of these firms would eventually spin off at least thirteen laser-producing or -using firms. By 1987 MM had directly or indirectly spawned a total of twenty new firms. This substantial family tree established spin-off as the single most important process in the growth of the industry. This trend appears to continue today, although there are a few instances of growth from relocation of firms from other regions.

The Orlando area laser industry has been marked by a dramatic entrepreneurial spirit, recognized as a trait common throughout the industry (Bromberg 1991). In the Orlando area, this entrepreneurialism has had a distinctive character. The founders of these spin-off firms most often chose to form their own company in order to pursue a technological opportunity that the resources and/or inclination of the parent firm would not support. Indeed, the process of spin-off in the Orlando laser industry most often begins with the desire of an engineer to pursue his or her "great idea" for a product. Although many of these splits result in considerable animosity between parent and spin-off, these ill feelings are usually not due to the spin-off creating competition for the parent. Rather, they are due to the perception, often correct, that the spin-off is taking away important skills and information possessed by the founder of the new firm.

These new firms most often operate in a market niche that is occupied by other firms outside the Orlando area or a specialized niche of their own creation. The original market for local firms consisted entirely of MM, which was a strictly military market. However, by 1989, defense accounted for only 23% of total industry sales. Industrial, component, medical and scientific markets constituted over three- quarters of the competitive activity of local firms (Table 6.1). Although the sectoral diversification of the industry expanded rapidly during this time, product diversification and development at the firm level remained low, with many of the firms producing only one or two products.

Table 6.1: Market participation of Orlando's Laser Firms in 1989

Sector	Percent
Military	23
Industrial	33
Components	20
Medical	17
Scientific	7

From: Schwartz 1995.

This slow pace of product diversification at the firm level is largely the consequence of the business acumen of the new entrepreneurs. Few of the founders of these spin-offs had any business background. They were trained as engineers and it is in engineering that their skills were sharp. The learn-as-you-go system of business management is the prevailing strategy among these firms. Even today, most small firms in the cluster do not have a business plan or an appreciation of its importance. Few of these entrepreneurs have the time to seek instruction in the business skills they lack, and fewer are willing or able to hire business managers with the appropriate skills.

Many of these new entrepreneurs find themselves somewhat overwhelmed with trying to manage and administer both the engineering and the business facets of their new company. Consequently, both facets tend to suffer. For most of these new entrepreneurs, the most important source of information about how to run a business is the example provided by the owners or managers of the parent firm. This process of mentorship suggests that a good indicator of the future success of a new laser firm in the Orlando area is the previous success of the parent firm. This informal and somewhat haphazard manner with which these engineer-entrepreneurs have mastered the business side of business has made the development of local institutional support for the industry a critical factor in its ability to grow.

A local institutional base of support for the spin-off process did not emerge for nearly two decades after the first spin-offs occurred. In other regions, such as Silicon Valley and Route 128, the emergence of a new high-tech industry (in these cases, computers) was preceded and then supported by the development of the technology at a local university. These universities played a critical institutional role by providing support for the intensive and expensive research and development that is required to give birth to a new industry based on new technologies. In Silicon Valley Stanford University played this role, and in Boston's computer industry MIT was responsible for providing this foundation. In the case of the Orlando laser industry, this role was filled not by a university but by a corporation, Martin Marietta, that financed its research and development efforts almost entirely through defense-related contracts.

Not until 1987 when the Center for Research in Electro-Optics and Lasers (CREOL) at the University of Central Florida (UCF) opened its doors did the local laser industry gain academic institutional support. Support from an academic institution has two key advantages over that of a corporate institution. First, the flow of new knowledge from a university research center is much less restricted by veils of corporate secrecy. Although universities are not immune from the need to protect intellectual property rights, the chief aim of the university is to create and disseminate knowledge. Second, because it is not restricted to research and development devoted to a specific sector of the economy (defense for instance), the university can support the development of a much broader range of technologies. In these two important ways the institutional support of a university provides local high-tech industry with the ability to develop a diverse product line that is based on state-of-the-art research that is accessible to a large number of people.

CREOL provides the Orlando area optoelectronics industry with a wide range of scientific and technical knowledge through its many research endeavors. Most of this knowledge is available to anyone seeking information that will aid in developing a new product or the improving an existing one. In the ten years since CREOL opened its doors it has grown significantly in both size and capability. In accordance with its established mission statement CREOL attempts to support the local industry in three ways: (1) to provide access to state-of-the-art research and research facilities, (2) to become a breeding ground for firm and product spin-off, and (3) to provide a well-trained labor pool in the form of its graduates.

Another important source of institutional support is sometimes found in professional organizations. The Laser Institute of America (LIA) moved to Orlando in 1989, during a period when Dr. William Schwartz, an entrepreneur responsible for two successful local spin-offs in the laser industry, was serving as president of the organization. This professional society functions largely as a trade organization. The institution provides a broad range of support to local firms, much of which falls into the category of traditional business information, including market information, management information, and other general support. Although these contributions by CREOL and LIA are important, mentorship remains the single most important source of business management or administration information for the new entrepreneur.

Despite the difficulty with which new entrepreneurs obtain business skills, the optoelectronics sector in Orlando has managed to grow significantly since 1962. Today the number of optoelectronics firms in the Orlando area numbers between forty and fifty, depending on when the count was taken and who did the counting. More importantly, the industry has expanded well beyond its original dependence on the defense industry. The end of the Cold War brought difficult economic times to many regions whose high-tech industries where predominately defense related. Although the Orlando area has absorbed its share of cutbacks and employment losses, the overall effects on the area's high-tech base has not been as severe as in other areas.

A quick comparison with Brevard County and the "Space Coast" illustrates this different fate. Brevard County's high-tech industry is based almost entirely on the Defense and Aerospace sectors. Major layoffs related to cutbacks in these two sectors have taken place at NASA, the Harris Corporation, and McDonnell-Douglas. These three corporations alone have accounted for the loss of more than 3,000 high-paid high-skilled jobs, and have also put severe pressure on the many smaller firms that rely on subcontracts from the larger firms to stay alive.

In Orlando the situation is similar yet different. Although layoffs at Lockheed-Martin and several other defense-related firms have also put several thousand people out of work, the area has seen the rise of a substantial number of high-tech firms, many of them optoelectronics firms, that operate in various markets outside defense and aerospace. Rather than relying on a small number of large firms operating in few markets, the Orlando area's high-tech base is composed of a larger number of small- to medium-sized firms operating in a variety of markets. Whereas the high-tech base of the Space Coast has struggled to maintain a footing on shrinking markets, the Orlando area has seen its high-tech economy expand rapidly because of the growth of firms in such markets as medical devices, scientific instruments, scanning, coding and marking devices, optical sensors, communications equipment and computer hardware and software.

The ultimate ability of the Orlando area to achieve its goal of becoming a global center of high-tech firms rests largely with this ability to support a diversity of firms. Although these firms all draw on a related knowledge base (optics), they nevertheless produce a wide variety of products. Without this characteristic it would be difficult for the Orlando area to count on high-tech industry to play an important role in the local economy. An important reason for this diversification lies with a special characteristic of the optoelectronics sector itself. Understanding the nature of the technology goes a long way in explaining how the Orlando area is managing to stimulate its high-tech base even though the traditional major markets for high-tech goods are shrinking. Furthermore, understanding the nature of this sector will help us to understand why Central Florida and other regions exert so much effort to develop a high-tech component in their local and regional economies.

Lasers Technological Opportunity and Central Florida

In the preceding pages I have used the term "technological opportunity." The concept of technological opportunity is crucial to understanding the ability of the laser industry to provide a significant high-tech component in Central Florida's economy despite the loss of significant numbers of high-tech jobs. Coombs *et al.* (1987) describe two forms of technological opportunity, intensive and extensive, both of which are important factors in the growth of the optoelectronics industry.

Extensive technological opportunity refers to a technology's ability to be used in "... technological systems where it can serve a variety of functions more efficiently than the existing technologies in use (Coombs *et al.* 1987: 44)." In contrast, intensive technological opportunity refers to a particular technology's capacity for, "...improvements in an existing specification/performance relationship (44)." A high degree of intensive technological opportunity suggests that as we learn more about the basic science that supports a technology (optics, in the case of lasers), we will be able to use that technology for more applications, in more markets. On the other hand, a high degree of intensive technological opportunity suggests that a growing knowledge base will result in increased capabilities in existing systems. The laser industry exhibits both vast extensive and intensive opportunities.

Many good examples of technological opportunities can be drawn from the laser industry. A particularly good example for grasping the concept comes from the field of medical instruments. For some time now many surgeons have employed laser devices where traditionally a scalpel would have been used. In this example of extensive technological opportunity, the laser has replaced an existing technology because it is able to do the same job more efficiently and effectively. The first laser cutting devices for surgical use, however, were characterized as having limited capabilities. This was the case because the laser's intensive technological opportunities had not been fully developed. Each new surgical capability required entirely new laser technology (different types of lasers are needed to cut through different types of tissues). Eventually, after much research and development, the intensive technological opportunities of the surgical laser were realized, and today surgeons can choose from numerous lasers of different strengths and capabilities to perform their art. Economically the consequences of this phenomenon are clear: the opportunities for product development are vast. Entrepreneurs are presented with abundant opportunities to establish new firms and add to the diversity of a regional high-tech base.

The enormous technological opportunities presented by laser technologies were not always recognized. In fact, early laser pioneers were often chided for having created a solution without a problem (Coombs *et al.* 1987; Kotte *et al.* 1989; Sternberg 1992). The first applications of laser technology were primarily military in nature. Within three years of the creation of the first operative laser, several hundred companies were undertaking research in the field, and 20 to 30 were actually manufacturing laser systems or components (Bromberg 1991: 128).

A powerful scientific and entrepreneurial fervor swept through the research community and, combined with relatively low barriers to entry, resulted in a remarkably swift development of the technology and its potential applications. Bromberg (128) describes the genesis of this process: "In 1960, scientists and engineers at giant facilities and diminutive companies alike were going to their laboratory benches and using the published articles, their own expertise, and the know-how informally communicated by others in the field to recreate the ruby laser." With this step accomplished, multitudes of research groups set out in varying directions to develop their own versions of the new technology. By the end of the laser's first decade, "The number of laser-related papers listed in *Physics Abstracts* [was] over 1,000 per year... (Bromberg 1991: 159)."

This was the beginning of the process that unveiled the vast technological opportunities inherent to laser technology. Today, far from wondering what the laser can do, the technology is commonly regarded as being limited in its applications only by the imagination. The early problem of developing applications was addressed head-on by the research community, who always knew the potential of the technology. Whereas the 1960s were dominated by basic research into the nature of lasers, the 1970s saw an explosion of efforts to develop applications. During this time, the U.S. Department of Defense and several large firms established programs designed specifically to discover new applications for the technology. In addition, professional organizations such as the Optical Society of America, the International Congress on Applications of Lasers and Electro-Optics, the Lasers and Electro-Optics Society and others were formed to speed the development of applications. This endeavor became a prominent theme at the annual meetings held by these organizations (Charschan 1983; Goodman and Ross 1980; Kimmitt 1983; Lampropoulos *et al.* 1995; Ross, 1971; Spasov 1986).

Today the use of optoelectronic technology is pervasive throughout the economy. The following table (6.2) is derived from a number of sources and serves to illustrate the degree to which firms have taken advantage of the technological opportunities inherent in the laser.

Table 6.2: Photonic Technology: Markets and Applications

Markets	Applications or Devices
Medical	Non invasive imaging, automated microscopy, tattoo removal, cauterizing scalpel, eye surgeries, dentistry, tumor removal.
Military	Range finding, target designation, battle simulation, weaponry, fiber-optic communications, proximity fuses, night vision.
Energy	Laser fusion, isotope separation
Scientific	Illuminating cells, measuring concentrations of pollutants or other chemicals, studies of atomic, and molecular physics, controlling chemical reactions, materials analysis, inducing fluorescence.
Industrial	Materials processing: cutting, welding, drilling, marking, heat treating; quality control: sensors, measurement, integrated circuit photo mask repair
Communications/Information	Fiber optic networks, bar-code scanning, laser printing, laser optic wiring, optical processing.
Consumer Electronics	Audio, video, and data *disks*, both permanent and erasable,
Process Control	Sensors, detectors.
Aerospace	Displays, fiber-optic wiring, sensors, imaging.
Safety and Security	Sensors, imaging, fiber optics.

Sources: Beach *et al.* 1993; Bromberg 1991; Hansen 1992; Hecht 1994; Kotte *et al.* 1989; Miyazaki 1995)

The Orlando area optoelectronics industry operates in nearly all of these different markets. This diversity has caused the industry in the Orlando area to respond to the economic pressures of the end of the Cold War in a very different manner from other areas. Although cutbacks in defense spending forced Martin Marietta to lay-off more than a thousand employees, this event did not lead to a crisis in the Orlando area optoelectronics sector. Ironically, this substantially negative event may have many positive consequences for the overall health of the local industry.

The silver lining on this cloud could appear in several forms. Many of those who lost jobs were highly-skilled engineers. The availability of large numbers of well educated and experienced potential employees could act to encourage high-tech firms outside the region to relocate to the Orlando area. In fact, one of the reasons for moving to Central Florida cited by the managers of relocated firms is the presence of a technology oriented labor force in the area (Dillon 1996). In addition, it is likely that at least some of these engineers will attempt to form their own firms thus spawning a new generation of spin-offs. Finally, these engineers are now able to spread their own knowledge of optoelectronics throughout the area's industry. Only time will tell just how the end of the Cold War will ultimately influence the evolution of the area's optoelectric cluster. The point is, by the time the end of the Cold War was becoming a bitter economic pill to swallow for many areas, Orlando's optoelectric sector had already diversified to the extent that layoff from one large employer could be seen more as part of a transition than as the loss of an economic base.

The Orlando area is clearly in a better position to put the Cold War behind it and get down to the business of providing competitive products for the new global economy than other regions that depended on technologies with less inherent opportunities. The vast product development opportunities presented by optoelectric technologies together with the entrepreneurial spirit that has accompanied the rise of the industry has provided the Orlando area economy with a firm and growing high-tech component. Furthermore, the diversity of the local industry has provided a buffer against the fluctuations inherent in the traditional high-tech markets. None of these facts, however, explains why an area with such a robust tourist economy is so concerned about developing its a high-tech sector. Central Florida's boosters obviously recognize the high-tech industry's contribution to the local economy that the tourist industry, no matter how robust, cannot provide.

High-tech's Contribution to the Central Florida Economy

Tourism remains the primary industry in Central Florida, with employment figures that dwarf those of high-tech industry. During the economic recession of 1990-1992, it was the flow of tourists from abroad, mainly Europe, that kept the area economy afloat. As the economy began to rebound, the tourist industry led the recovery. Tourism has often been referred to as Central Florida's life blood(*Orlando Business Journal* 1992). Yet, local boosters are most eager to discuss the high-tech component of the economy. The section devoted to Central Florida in the *Florida Trend 1997 Economic Yearbook* barely mentions tourism while it expounds at length on the growth of the high-tech sector (Henderson 1997). The answer to this apparent paradox lies as much with the character of tourism as an economic base as it does with the benefits of high-tech industry.

Orlando is an obvious example of how certain communities can use tourism effectively as an economic development tool. Tourism tends to function much like a manufacturing industry in a local economy in that it brings in large amounts of income from outside the region, and provides fuel for economic growth. A problem often cited with economies based on service industries is that money may tend to flow within the region rather than into the region, so that not enough new money comes into an area to support economic growth. Clearly, tourism does not suffer from this problem. In order to see the inherent weakness of tourism as an economic foundation it is first necessary to identify what the tourist industry is.

The tourist industry consists of an array of different economic activities that are tied together because they all function largely, if not primarily, to serve the tourist. The sectors of the economy regularly included in the tourist industry are: 1) lodging establishments (hotels and motels), 2) amusement and recreation facilities, 3) eating and drinking establishments, and 4) apparel and accessory retail outlets. In some areas, where one of the chief goals of promoting tourism is to encourage visitors to buy a house and move to Florida, the real-estate and construction industries can also be a component of a tourist industry. Although real estate and construction are indirectly linked to the tourist industry of Central Florida, this link is much more prominent in South Florida and the Panhandle.

Several important characteristics of these economic sectors stick out like a sore thumb. First and perhaps most noticeably, they employ a large number of people, which is certainly a positive attribute. Unfortunately, this characteristic is often overshadowed by two important negative characteristics of these sectors that are also very visible. First, they are extremely vulnerable to fluctuations in the economy at large. The tourist dollar is discretionary income. When the economy is slow, most people are forced either to put off their vacations or to spend less time and less money on their vacation. During economic slowdowns, state and national parks and other less expensive and more nearby facilities tend to get more visitors than when the economy is healthy. Because of this characteristic, a regional economy that puts all of its eggs in the tourism basket is taking the dangerous risk that the economy in general will be strong.

The lack of a buffer from the economy at large can be a serious problem when combined with the second negative aspect of tourism led economies. This characteristic is the notoriously low level of wages and the "dead end" nature associated with jobs in these sectors. Although these jobs often provide good experience for individuals just entering the workplace, they often result eventually in a lower quality of life because they cannot support the rising expectations that come with age and experience. It is difficult if not impossible to buy a house and raise a family on the income generated from employment in these sectors. Because they also restrict the local tax base they result in a lower standard of living for the community at large as well. Furthermore, the level of local discretionary income suffers from the inability of workers in these sectors to save at any meaningful rate.

On the other hand, jobs in the high-tech sector enjoy much the opposite reputation. High-tech jobs are located in a number of different economic sectors. Indeed, jobs related to optoelectronics are found in many different classifications. Typical high-tech employment sectors in the Central Florida region include the following: 1) Industrial and commercial machinery, 2) electronic and other electric equipment, 3) and instruments and related products. Orlando's laser firms are found throughout each of these classifications. Employment in these sectors offers a much higher average wage than tourism-related employment, as well as the opportunity for advancement and career building. A more attractive tax base contributes to a higher quality of life for the community at large.

In Central Florida direct comparisons between tourism and high-tech related employment are very telling. Tables 6.3 and 6.4 show the average annual wages for these different sectors and provide a means of direct comparison. Brevard County is included as an important further example of the potential contribution of high-tech to a local economy. When seen in this fashion, it becomes clear why Central Florida's boosters are so eager to see high-tech succeed in the region. In Orange County, the average employee in the tourist industry earns only 42 per cent of the average high-tech employee's salary, or $21,123 less per year. In Brevard County, the tourism employee earns 30 per cent of the average high-tech employee, or $26,883 less per year. These figures go a long way in explaining why high-tech has become a focus of area boosters. As John Todd, the president of Skydata, a satellite communications firms in Brevard county recently said, "I'm not belittling anybody, but if you base your economy on people who make beds in a motel, you have a severe problem in your tax base" (Dickey 1997: 130).

Table 6.3. Average Annual Salary (in dollars) of Employees in Tourism-Related Industries, 1995.

Tourist Industry	Hotels, Motels, & Lodging	Amusement & Recreation	Eating & Drinking	Retail Apparel & Accessory	Average for Activities
Orange	16,650	21,881	12,240	12,758	15,882
Brevard	11,479	13,324	8,649	13,526	11,746

Source: Derived from statistics reported in *Florida Statistical Abstracts*, 1996. Bureau of Economic and Business Research

Table 6.4. Average Annual Salary of Employees in High-tech Related Industries, 1995.

High-tech Industry	Industrial & Commercial Machinery	Electronics & Electronic Equipment	Instruments & Related Products	Average of these Activities
Orange	43,816	33,536	33,662	37,005
Brevard	24,970	44,319	46,296	38,628

Source: Derived from statistics reported in *Florida Statistical Abstracts* 1996. Bureau of Economic and Business Research.

Central Florida will probably always be recognized as a premiere tourist destination. Although tourism in the area provides millions of people with a vacation experience of world-class quality, it is unable to provide a long term base for the development of a world-class quality of life. Many people in Central Florida believe that the development of the laser industry offers a potential solution to this problem. The vision of Central Florida that its boosters are promoting is not of a place where high-tech industry has replaced tourism in the economic landscape. Such a goal would clearly be overwhelming and not entirely desirable. More precisely, the vision is of a region that boasts a broad economic diversity. This new economic region will be able to weather both normal and severe economic fluctuations, and to provide its citizens with a quality of life that promotes family and career development as well as economic growth.

The Orlando area is fortunate to have a long history with the optoelectronics industry. The technological opportunities inherent to this industry can provide the basis for continued development and diversification of the high-tech component regional economy. The Orlando area's ability to provide the local industry with access to both skilled employees and modern research facilities will ensure the region's ability to take advantage of these opportunities. If local boosters get their way, Central Florida will always be much more than just a place to visit Mickey, buy a T-shirt, and get a tan with Shamu.

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7

Citrus in Central Florida

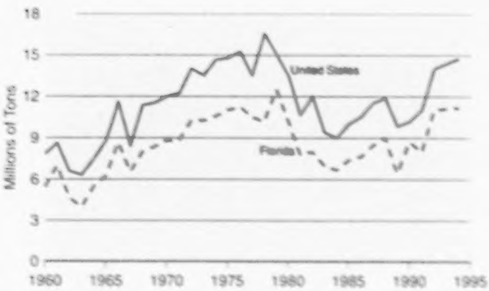
Cesar N. Caviedes

Considered by a traveller of the 1940s one of the most perfect demonstrations of human ingenuity and as an example of the transformation of nature by human action, Florida's citrus industry continues to impress tourists and travellers who venture through the central part of the state.

The effort involved in the maintenance of this "miracle of human ingenuity" and the adverse circumstances that have beset this industry, particularly during the last two decades, are not revealed by a superficial glance at the green lush groves that spread serenely amid busy highways and bustling towns.

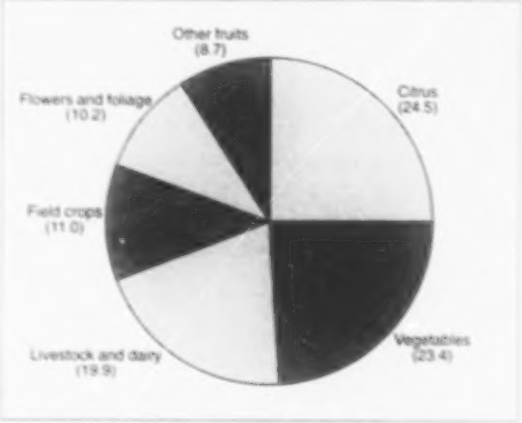
The Place of Citrus in Florida's Agriculture

Accounting for roughly 75 percent of the annual citrus production in the U.S., (Figure 7.1), Florida, with 10.5 million tons, commands this industry well ahead of California (3.5 million tons), Texas (144,000 tons), and Arizona (364,000 tons). In terms of receipts, this constitutes approximately 24.5 percent of the annual revenues generated by agriculture in the state. Other agricultural commodities generate less, such as vegetables and melons (23.4 percent), foliage and floriculture (10.2 percent), field crops (11.0 percent), and other fruits. Livestock and dairy products account for nearly 19.9 percent (Figure 7.2).



Source: "Citrus Summary 1995–1996," Florida Agricultural Statistics, 1996.

Figure 7.1: Total Annual Citrus Production of the United States and Florida (1960–1995)



Source: "1995 Florida Statistical Abstract," Gainesville, 1995.

Figure 7.2: Contribution of Agricultural Products to the Income Generated by Florida's Agricultural Sector

Of the total citrus production, oranges make up 77 percent, and grapefruits 20 percent of the total, while the rest is divided among other less abundant, albeit highly-priced citrus, such as tangerines, tangelos, limes, and lemons.

Oranges are grown in many varieties. The earliest oranges on the market are the *Hamlins*, a cold-tolerant and high-yielding variety that is harvested from October through January. Also early are the *Navels*—not a bountiful variety—which are harvested from the end of October through the end of January. Mid-season oranges are the *Pineapple*, a pleasant but not very cold-resistant fruit that matures from December through February. The latest oranges are the *Valencias*, of excellent color and flavor, that are harvested from March through June.

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It is estimated that 94.5 percent of the annual orange production end up as fresh juice and concentrate, leaving a rather scarce volume for fresh consumption. The price of specialization makes Florida's citrus industry vulnerable because of the penetration of foreign orange-juice producers, such as Brazil and Mexico. The import of fruit concentrates from those two countries started after the devastating freezes of the 1980s (1983, 1985, 1987 and 1989) that caused a deficit in the supply of orange juice on the American market. Even though the production of orange juice concentrates has returned to its former levels, major juice producers discovered that it makes good economic sense to mix Florida orange juice with less expensive Brazilian juice and thus encourage more widespread consumption of their product. At present, there is talk about a major Brazilian orange juice producer acquiring citrus land in southern Florida, possibly to take advantage of the government regulations for American citrus producers concerning national distribution and possible exports.

Grapefruit cultivation has reached a high level of productivity in the last 25 years, as the demand for juices in the American and European markets has skyrocketed. Consequently, the surface occupied by grapefruit in the state has increased from 103,000 acres in 1966 to 135,000 acres (41,715 ha to 56,675 ha) in 1995. The varieties most cultivated were the yellow-peel *Duncan* (maturing from December-May) and the Marsh (November-May), but in recent years these have been replaced by the pink or red-fleshed *Ruby* (November-May) and the *Foster* (November-March), the favorites among consumers of fresh grapefruit.

Mandarine is the generic name for all small, deep-orange-colored citrus that peel easily and offer sweet-savory sections. Although not intensively cultivated, they satisfy the state's demand for fresh mandarines, whereas the Japanese and Spanish imports dominate the American market for canned mandarines. Other popular small citrus varieties are the tangerines (*Dancy*, *Sunburst*, and *Robinson*), the tangelos (*Minneola* and *Orlando*), and the mandarines proper (*Satsuma* and *Ponkan*), all of which ripen between November and March, and are freeze-sensitive.

Limes, are also very freeze-sensitive and grow well in the southernmost part of the state and meet Florida demand only, whereas lemons are cultivated in small quantities in a variety of localized settings.

Areas of Cultivation

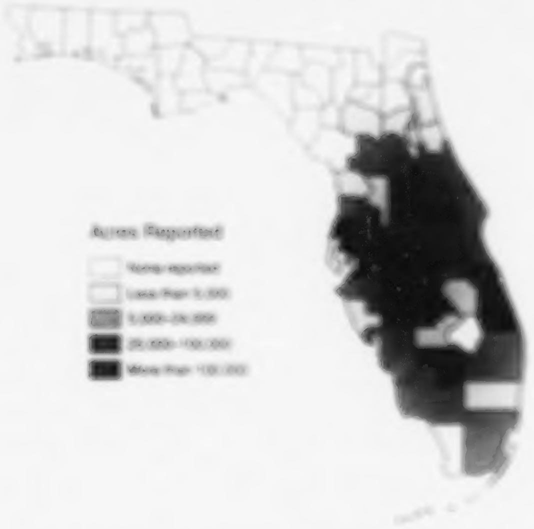
The Spaniards introduced citrus fruits to Florida in the Saint Johns River area, inland of St. Augustine, and also in the Tampa Bay area. The subtropical cultivar did quite well in the Saint Johns River area up to the two freezes of 1894 and 1899 that killed most of trees. In counties such as Duval, St. Johns, and Putnam, where citrus trees are all but gone today, many place names that have to do with citrus testify to the early agricultural history of those counties.

After the devastating freezes of the end of the century, citrus cultivation moved into the central highlands of the peninsula, from Marion County to Hardee and DeSoto counties. Subsequent freezes in 1928, 1934, 1940, and 1962 did not affect the distribution of citrus groves, which, on the eve of the decimating freezes of the 1980s, looked as depicted in Figure 7.3.

From an agronomic viewpoint and as far as the concentration of certain orange and grapefruit varieties is concerned, citrus production in the Florida peninsula is found in five major regions:

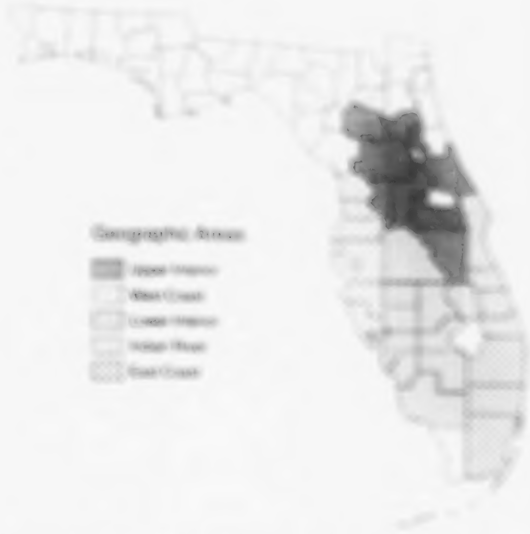
(1) the upper (more northerly) interior region including the counties of Alachua, Marion, Putnam, Volusia, Lake, Sumter, Seminole, and Orange where 8.9 percent of the production is concentrated; (2) the west coast region comprising the Gulf counties, from Citrus to Sarasota, with 8.1 percent of the production; (3) the lower (more southerly) interior region with the central counties from Polk to Charlotte that produce more than half (50.2 percent) of Florida's citrus; (4) the Indian River including the counties of Brevard, Indian River, St Lucie, and Martin, with 31.3 percent; (5) the east coast region, from Palm Beach to Dade County, with only 1.5 percent of the production (Figure 7.4).

After the damaging freezes of the 1980s, a definite trend began toward moving new citrus groves southward into the southern interior region, almost to the northern boundary of the Everglades. In 1996, the largest acreages dedicated to citrus were located in the east-coast counties of St. Lucie, Indian River, and Martin, and also in the lower interior counties of Polk, Hendry, DeSoto, and Highlands. This high concentration in southern locations was dictated by the need to avoid future freeze damages and, at the same time, take advantage of new low-priced land locations (Figure 7.5).



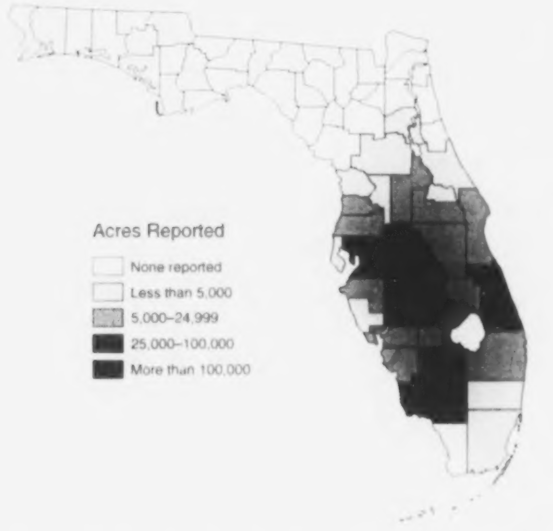
Source: "Citrus Summary 1980," Florida Agricultural Statistics, 1980.

Figure 7.3: Distribution of Citrus Acreage in 1980 Prior to the Major Freezes of the 1980's.



Source: Adapted from L.K. Jackson et al. "Introduction to the Florida Citrus Industry-Its Production, Harvesting, and Marketing Phases." IFAS, 1989.

Figure 7.4: Regions of Citrus Growing in Florida



Source: "Commercial Citrus Inventory 1996." Florida Agricultural Statistics, 1996.

Figure 7.5: Distribution of Citrus Acreage, 1994. Recovery after the 1980's Freezes.

With the exception of the good-quality oranges and grapefruits that are grown for direct consumption in the east coast counties—conventionally referred to as *Indian River* products—the major part of Florida's citrus production goes into fresh or frozen orange and grapefruit juices or concentrates. Although the large corporations dealing with these products are located in the lower interior counties, the processing plants are found in Lakeland, Bartow, Frostproof and Lake Wales (Polk county), Fort Pierce (St. Lucie), Avon Park (Highlands), Plant City (Hillsborough), and Umatilla (Lake county).

Freezes and Canker: Two Deadly Enemies

Two natural enemies of citrus—freezes and canker disease—have prompted dramatic spatial shifts in the areas of production and revolutionary changes in physiological citrus engineering.

From the very inception of this agricultural activity, freezes have been a major catalyst for changes in citrus cultivation. As already stated, the freezes of 1894 and 1899 caused the cessation of citrus growing in the St. John River area and its shift into the Central Highlands, and similarly, the freezes of 1983, 1985, and 1989 decimated dramatically the orchards in the northern part of the peninsula and forced the translation of newly opened orchards into southern locations.

One distinguishes two kinds of freezes depending on the meteorological conditions that trigger them: radiative freezes and advective freezes. *Radiative freezes* occur under clear skies and in calm weather conditions, when temperatures near the ground drop below the freezing point during the night or in the early morning hours. Traditional methods for battling this type of freeze were the use of kerosene burners (often enhanced by burning tires), of elevated sprinklers, and of wind machines to try to raise the temperatures in the near-ground layer. Radiative freezes are particularly lethal for groves located in depressed topographic locations. *Advective freezes* are caused by continental cold air invasions from the northwest. This type of cold spell is of longer duration and is accompanied by chilly winds. Most sensitive to damages are the groves in high and wind exposed locations. Burners, wind machines, fires and elevated sprinklers are of little use aginst this type of freezes. Only tree barriers as wind breakers and a sheltered location on the leeside of the incoming winds, or vicinity to a lake can muffle the damaging effects of advective freezes. The freezes of 1983, 1985, and 1989 were of the advective kind, and their damages were extremely severe (Figure 7.6).

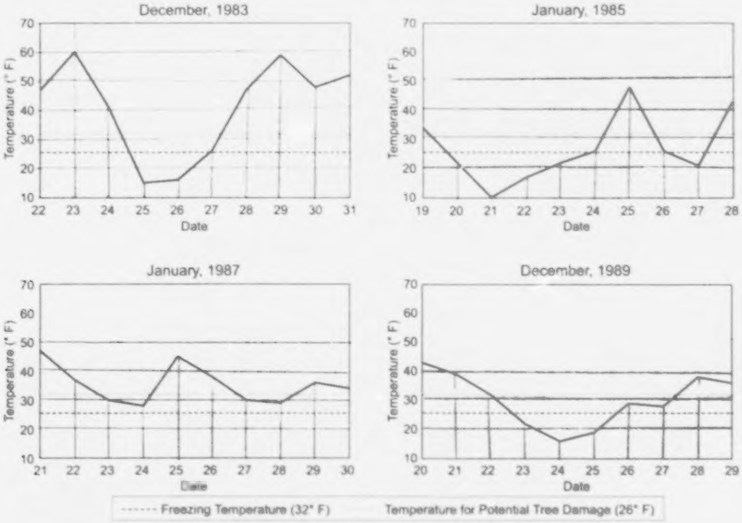


Figure 7.6: Critical freeze temperatures in 1983, 1985, 1987, and 1989
Data taken from "Climatological Data, Florida," National Climatic Data Center, Asheville, N. C.

Citrus will not necessarily be damaged as soon as temperatures drop below 32°F (0°C). Certain thresholds must be passed: below 26°F (-3.3°C) freeze damages to tender leaves and branches and loss of fruit occurs, although it takes more than four hours of temperatures dropping below 22°F (-5.6°C)—as usually happens during cold air snaps—causing the bark of thicker branches and trunks to freeze and split open, which makes the tree bleed to death as temperatures rise again.

Canker is another hazard that has threatened the survival of citrus cultivation in the Central Highlands. This incurable bacterial disease is caused by the rod-shaped bacterium *Xanthonomas campestri pv. citri* that enters natural openings in the leaves or twigs of young seedlings and the fruit in mature trees. The enzymes produced by the bacteria create brown spots or crater-like lesions that cause the leaves to drop off and the twigs to decompose, ultimately leading to the death of young trees. Under atmospheric conditions of great humidity and warm temperatures (77°F to 95°F or 25°C to 33°C) the pathogen flourishes and oozes out of the host; it can be swept by winds, or spread through contact with insects, equipment, or humans. When just one or a few trees in a grove or nursery show signs of infection, the whole stand must be exterminated. In 1984 canker infections erupted in some counties of the Central Highlands among the young trees that were replacing losses from previous freezes. The destruction of approximately 2.5 million young trees was the only counter-measure available.

Other pests to inflict damages to citrus trees are blight, fungi of different kinds, and insects. Blight is a disease that affects orange trees, particularly those around 5 years of age. It shows as premature leaf drop, sparse foliage development and small, not-fully ripened fruits. Mainly affected are groves in the flatwoods areas near the Atlantic coast and in marshy areas of the peninsula's interior. What causes the appearance of blight is not yet well understood, however, some growers associate it with a weakness of the rough lemon that is used as rootstock.

Fungal diseases such as scab, melanose, and greasy spot are more damaging to citrus trees than insects or mites, for they destroy tissue in young fruit, leaves, and twigs. For this reason, antifungal sprays are applied at least four times a year: at flowering time, in spring, in summer and in autumn. It is also necessary in Florida citrus groves to apply insecticides, especially during the humid seasons, against annoying pests such as purple scale, red scale, citrus snow scale, white flies, aphids, citron bugs, and root weevils (a beetle).

All this points to the fact that keeping a citrus grove productive demands an extraordinary effort of labor and a detailed knowledge of nutrient dosages and appropriate fungicide and pesticide sprays.

The Innovations Triggered by the Freezes of the 1980s

As in the case of the freezes at the end of the nineteenth century, the freezes of the 1980s prompted substantial changes in Florida's citrus cultivation that, probably, will leave an imprint on citrus growing in the century to come.

For one, they marked the ultimate demise of small and mid-size growers on what is called the "northernmost fringe" of Florida—Marion, Flagler, Volusia, Citrus, and the northern part of Lake county—which, unable to recover from the successive freezes, were forced out of business. This prompted the expansion of large citrus enterprises into southern counties and the consolidation of large citrus groves in the Indian River counties St. Lucie, Martin, and Indian River. It is here where, at the end of the 1990s, we see the most vigorous expansion of the citrus industry when one compares the acreages at different time spans with the surface occupied by citrus in 1996 (Figure 7.7).

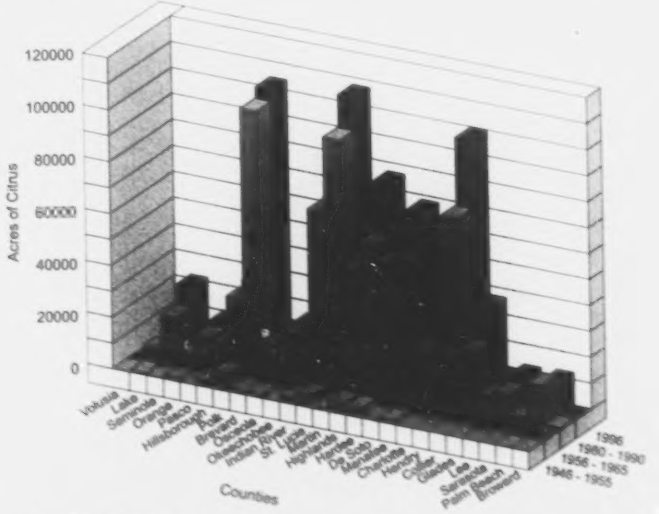
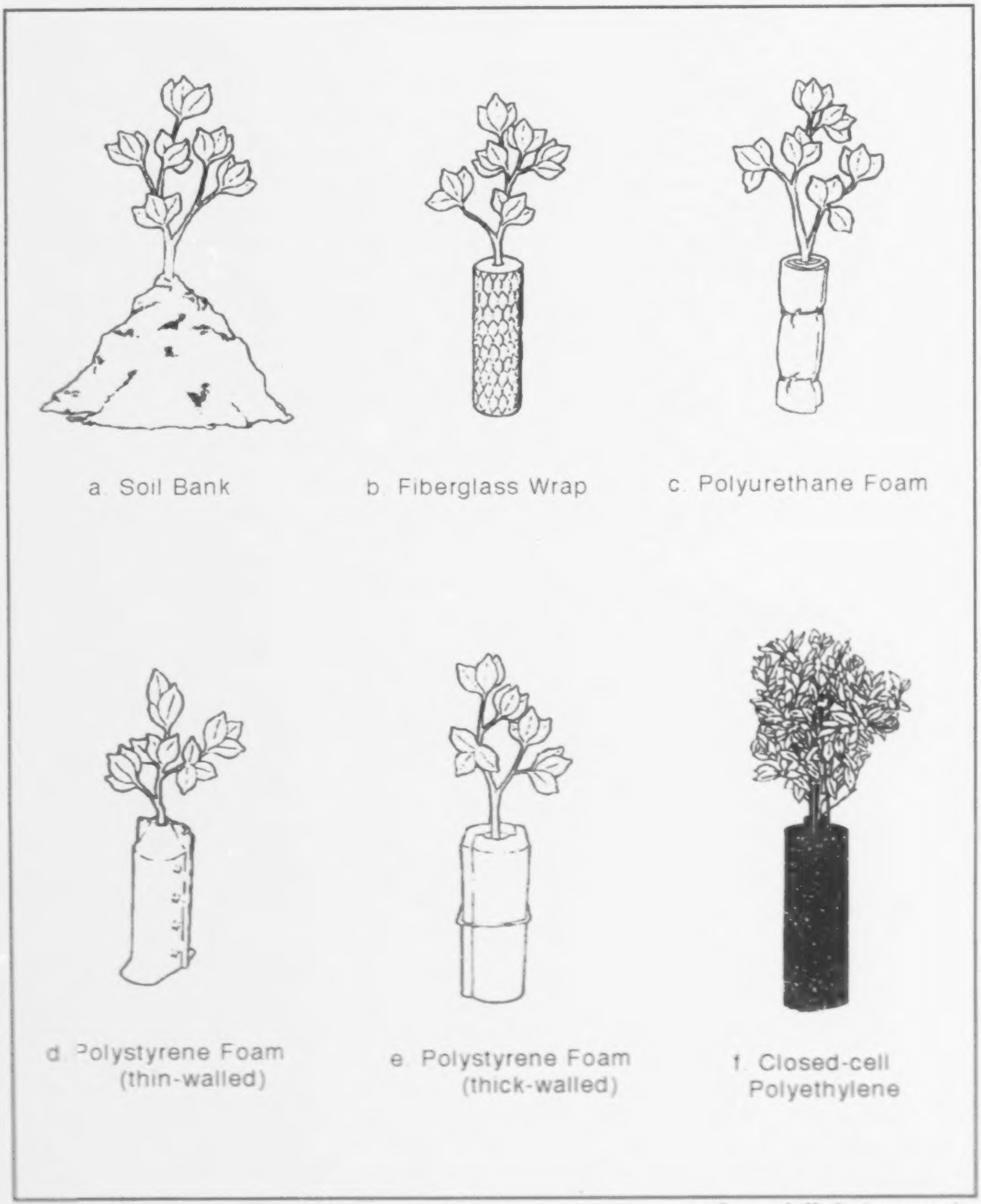


Figure 7.7: Total acreage by county in four different periods. The counties are arranged from north to south.
Source: "Citrus Summary," Florida Agricultural Statistics

In traditional citrus growing areas of the Central Highlands and mid-state lakes' region, the innovative change is not shown so much by spatial variations of acreage, but, it has taken more technological dimensions, such as the adoption of new protective measures that had to do with the physiological resistance of the plant and of new techniques for warding off freezes: tree wraps and microsprinklers.

The trees planted after the 1980-freezes were mostly hybrid varieties that combined resistance to pests and plagues from the *rootstock* (the root system and basal part of the tree) with the freeze-resistance and fruit quality of the *scion* (the upper part and foliage of the tree). Prior to the freezes, the most common rootstocks were the *Rough lemon*, the *Sour orange*, and the *Trifoliate orange*. These rootstocks were well-suited for the humid and warm conditions of the Florida summers, survived some serious freezes, and resisted soil parasites and fungi. They proved to be extremely sensitive to cold air outbreaks. Today they are being replaced by *Carrizo citrange*, *Milam lemon*, *Cleopatra mandarin*, and *Swingle citrumello*, that can



a. Soil Bank

b. Fiberglass Wrap

c. Polyurethane Foam

d. Polystyrene Foam (thin-walled)

e. Polystyrene Foam (thick-walled)

f. Closed-cell Polyethylene

Source L.K. Jackson, et al

Figure 7.8: Different procedures used to protect young budded trees.
Adapted from L. K. Jackson *et al.* 1989. *Introduction to the Florida Citrus Industry-Its Production, Harvesting and Marketing Practices.* Gainesville: IFAS.

better withstand freezes and lack of water and are less susceptible to blight attacks. Hamlin, Parson Brown, and Navel oranges are the preferred scions among the early season oranges; Pineapple among the mid-season oranges; and, the Valencias among the late season oranges. Close inspection will allow even a layperson to recognize the place where the *budding* (joining of rootstock and scion) was performed. In many young trees the budding section of the trunk is protected from cold air, parasites, and insects by a plastic wrap that is wound like a bandage around the lower part of the tree.

Budding—an operation conducted in late summer or early fall—makes it necessary to protect the tender part that has been operated upon by wraps. The traditional method of soil banking (Figure 7.8a), though, will interfere with feeding and irrigation, so, growers use various other tree insulators (Figure 7.8b-f). The wraps allow the insertion of drippers and micro-sprinklers to protect adequately the young trees against freezes. They usually remain on the trees up to three years.

Dripping is a new way of applying additional nutrients to the tree. In the past, mineral nutrients were supplied in bulk and distributed through copious watering, today feeding is done via drippers that are attached independently to the trees. Just as sprinklers can be adjusted to dose the water supply in times of heavy evaporation, these drippers not only supply water and fertilizers but during freeze conditions they function as effective temperature-raising devices for the young trees.

Also crucial to good management of citrus groves is tree spacing (orchard geometry). In the past, the trees were arranged in a rectangular geometry, the distance between rows being about 27 feet (8.2 m), and between trees 19 feet (5.7 m). With the new smaller citrus species, that are nevertheless more productive and more resistant, the distance between rows has been reduced to 20 or 25 feet (6.1 or 7.6 m), and the distance between trees in a row to 15 feet (4.6 m). This has resulted in a much higher tree density in the new orchards.

Another very visible change that resulted from the freezes of the 1980s is the abandonment of traditional methods of freeze protection. One can still find heaps of rusting kerosene burners and abandoned sprinklers installed atop metallic water pipes in some former citrus groves Even partially dismantled and vine-covered posts that once supported wind machines can be spotted. These last remnants of a once healthy and flourishing agricultural industry in Central Florida are quickly disappearing.

How do Growers See the Future of the Industry ?

Most of the observations reported above have to do with the changes in the physical landscape of Florida's former citrus growing core. This, however, is but one aspect of the substantial alterations experienced by this activity during the last two decades. The other is the effect of these disasters on the citrus growers at the northernmost fringe of the citrus growing belt.

Those following Florida's agricultural development have been wondering how, and if at all, the freezes of the 1980s have also changed the way of life, and the thinking of the citrus growers, and whether this region will have its comeback among the citrus producers?

In the early 1990s, a team of geographers from the University of Florida, the Florida Freezes Research Group, conducted a survey in the northernmost fringe among growers in Lake, Marion, Putnam, Volusia, Seminole, and Orange counties. Most of the small and mid-size citrus growers who filled out the questionnaire were mature individuals, their average age being 59 years. Thirty five percent of them were males in their sixties. Sixty percent indicated a college education and knowledge of the technicalities involved in citrus management. Their occupational background was predominantly in agriculture, with 66 percent having other family members involved in Florida agriculture, though not necessarily citrus. The majority had been in the citrus business for more than twenty years, which means they had acquired the experience needed for profitably operating a citrus grove.

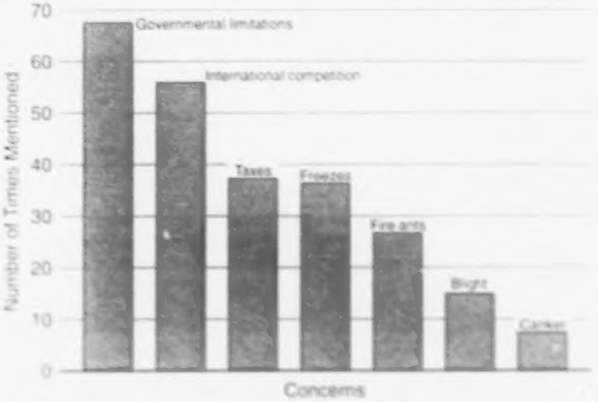
When asked whether they thought that there had been a secular (an irreversible) change in Florida's climate to winters with higher frequencies of freezes, the majority (73 percent) felt that the freezes of the 1980s were the most severe they had ever experienced, but rejected the idea that the climate had deteriorated to the extent of making citrus growing impossible in north-central Florida. An interesting confirmation of this optimistic outlook into the future can be seen in the fact that new trees are being planted in certain locations of Lake, Orange, Volusia, and Seminole counties, locations that after the feezes of the

1980s appeared to have been totally lost for orange cultivation. The locations chosen were south-facing slopes (to prevent the killing action of northwest winds during advective freezes), areas protected by tree wind breakers, and the vicinity of lakes to take advantage of the beneficial lake plume effect (heightened humidity and mellowing of cold air temperatures) and of the soil moisture.

As to their expectations of continuing in the citrus business, 55 percent of the interviewees said they did not consider giving up even though the freezes of the 1980s had dealt them a severe blow. Three-quarters of the younger growers (ages 30 to 40), and 65 percent of those aged 70 and over expressed the desire to abandon this form of enterprise.

Forty-four percent of the growers believed that citrus cultivation will continue in the area for the next thirty years, and they were prepared to change their methods of cold protection. Only 30 percent were pessimistic about the future of citrus in the north-central part of the Florida peninsula. The other 70 percent had an optimistic outlook and expressed their willingness to protect their investments by planting new varieties of greater cold hardiness and earlier-ripening fruit, or by shifting to the late-ripening Valencia that growers can harvest for juice concentrate even if freeze-damaged.

Aside from fears of freezes and canker, the medium-scale citrus grower perceived a greater threat in the competition from foreign sources of orange juice concentrates and in the numerous internal regulations imposed by the Florida and federal departments of agriculture and the limitations of the U.S. markets.Taxes imposed by federal and state government are also regarded as threats for the industry (Figure 7.9). Although citrus growers came out of these interviews as very entrepreneurial and independent individuals, 57 percent of the respondents indicated that the government should be more concerned about the industry's survival, and 62 percent were in favor of the government's imposing higher tariffs on foreign imports.



Source: Doris M. Edwards "Changing perceptions among citrus growers on Florida's northern fringe of the citrus belt," 1995.

Figure 7.9: Concerns Mentioned by Citrus Growers as Limitations for the Further Development of the Industry.

Since the freezes—being natural hazards—cannot be expected simply to cease, the answers from the optimistic growers show that this group is not ready to give up the fight yet: they are using all the information and facilities available to minimize the effects of the freezes on their groves. They will try and keep the local industry afloat, but it will probably remain small and become very specialized. Already, citrus is no longer the only enterprise for Florida growers; many indicated that they had started to supplement their income with other activities.

When requested to give some advice to young, enterprising individuals interested in growing citrus, the response was rather negative as 70 percent replied they would not recommend that anyone enter the citrus business.

This investigation revealed several interesting facets of citrus cultivation at its northernmost fringe. For one, citrus growing at an industrial scale is definitely a thing of the past in the region. Those who remain are no longer able to make a living in the citrus business, and the successors of these elderly growers will probably not continue with the activity.

In those locations where no groves remain, the land is used now as pasture and for grain growing purposes (the cattle industry has expanded into the northern counties) or for pine plantations that are used for for pulp. In the southern counties of the fringe the outlook for citrus is not very good either. Only in locations well protected from the winds or in the vicinity of ponds and lakes are new groves doing well. In areas exposed to wind and with poor, sandy soils, the relentless forward march of the developers—eager to convert agricultural land into residential areas for retirees seeking a place in the sun—has definitely been the death knell for citrus cultivation. Who could resist an offer to own "a house in the middle of an orange grove?"

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8

Everglades at Risk

Jonathan Byron

The Everglades, like the California Redwoods or the Grand Canyon, is one of America's most spectacular natural systems. The Everglades include America's largest and most magnificent wetland region. The rapid transformation of Florida over the past century threatens the health and existence of the Everglades. The most productive regions of the Everglades around Lake Okeechobee were converted into farm fields, and fertilizer run-off is damaging nearby native vegetation. The southern Everglades are starved for water, and are in decline. The wading bird population has been reduced to one-tenth of former levels. By all accounts, the Everglades is an ecosystem at risk; unless protected, it will continue to slide into decline.

Geography and Natural History of the Ecosystem

The historic Everglades covered most of Southern Florida, from an area near Orlando south (Figure 8.1). Although the Everglades region includes a variety of landscapes, the area is dominated by glades, or open areas. Although the glades might resemble a midwestern prairie at first glance, the plant species are quite different, and the Everglades are saturated with water most of the year. The Miccosukee Indians called the glades "grassy water." Marjory Stoneman Douglas, who has done more to educate people about the Everglades than any other person, refers to the Everglades as a "River of Grass." The high moisture levels lead to soils that are jelly-like and tremble.

The Everglades are remarkably flat. In many places, the overall change in the elevation is one inch per mile, or less. Although there may be local depressions or mounds, the water flows over many places in a thin, even sheet—although very shallow and slow moving, the water flows steadily over a large region. In some places, the river of grass was more than one hundred miles wide.

Areas of the glades that resemble traditional streams or rivers are referred to as sloughs (pronounced *slews*). The largest is the Shark River Slough at the southwest end of the Everglades core region.

Alligators, Crocodiles, other Reptiles

A hazardous alligator filled swamp may be the first image that comes to mind when anyone mentions the word Everglades. Although this image has some basis in fact, most alligators are not aggressive, and prefer to be left alone to bask in the sun. Alligators are generally not interested in prey as large as a human adult, but might attack small children or dogs if hungry. Females that are nesting will vigorously defend their territory against any animal that comes too close.

Although a few alligator attacks on humans are reported each year in south Florida, humans kill far more alligators than vice-versa. During the 1950s and 1960s, alligator populations dropped rapidly as human settlements expanded and hunting was unregulated. In the late 1960s, alligators were given protection as an endangered species, and the population quickly recovered. The alligator is now off the endangered species list, and limited hunting is allowed with a permit.

Alligators make important contributions to habitat diversity in the Everglades. When nesting, alligators dig small ponds. During the dry season, these ponds hold water and can serve as an oasis to many species of wildlife.

It is illegal to feed or disturb alligators in Florida. Like bears in the western U.S., alligators can lose their fear of humans if they are fed regularly. This could cause an increase in attacks on humans as alligators learn to seek out people when they are hungry.

Crocodiles are biologically distinct from alligators, and occur only in the extreme south of the ecosystem. The American crocodile (*Crocodylus acutus*) is about the same size as the American alligator (*Alligator mississippiensis*), but lives in salty or brackish areas around the coast. The American crocodile remains an endangered species.

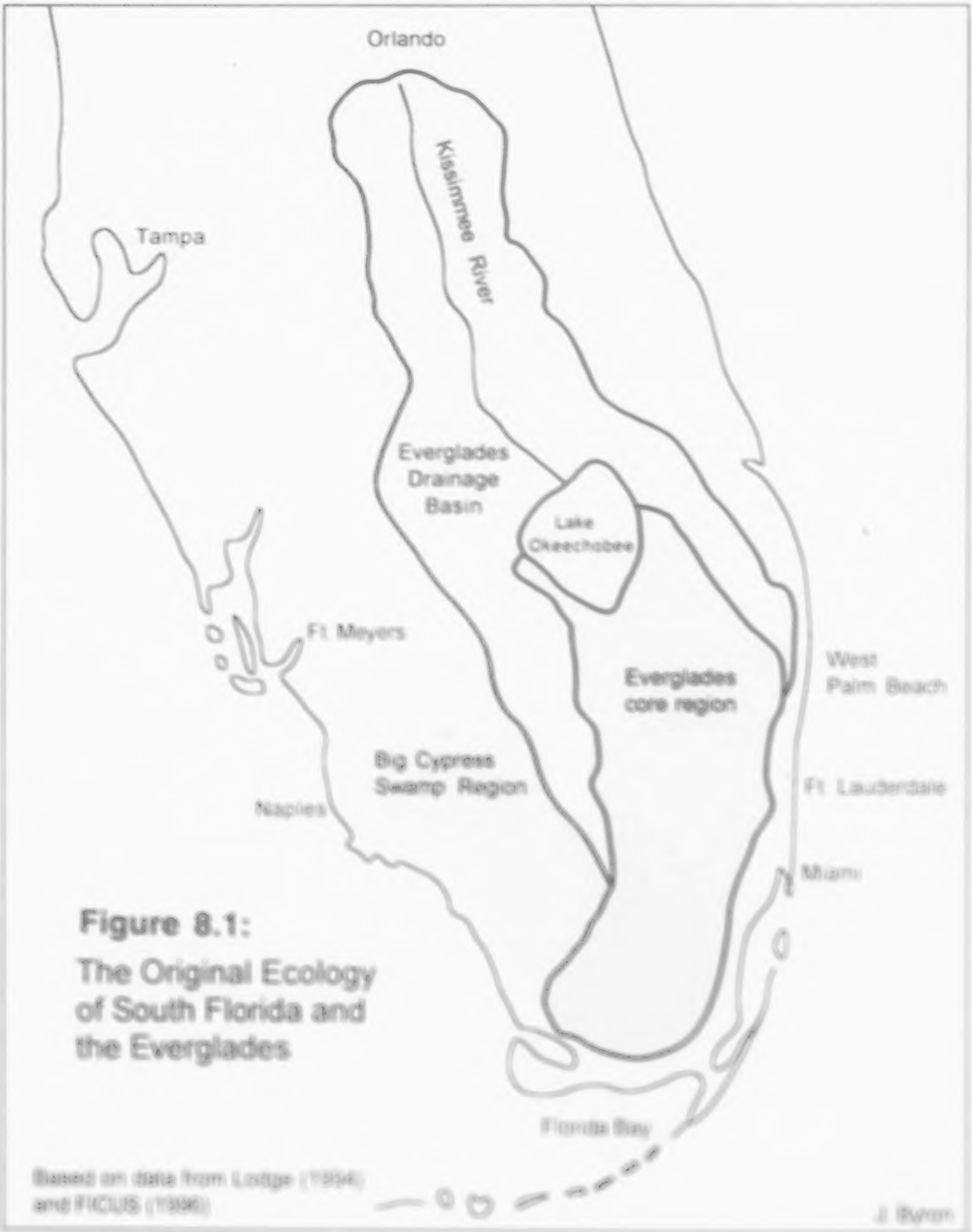

Figure 8.1:

The Original Ecology of South Florida and the Everglades

Based on data from Lodge (1994)
and FICUS (1996)

Other reptiles in the Everglades include ten species of turtles, three species of lizards (including the green anole, which is often sold as a chameleon in *Boy's Life* magazine), and sixteen species of snakes. One species of coral snake is extremely poisonous and rattlesnakes and water moccasins are present in much of South Florida.

The Florida Panther

The Florida Panther is the most endangered animal species in the Everglades. Approximately 50 panthers live in the wild today. Loss of habitat is the primary reason for the panther's decline. Each panther needs 50-100 square miles (130-260 sq km) of good habitat. The small number of panthers has led to what biologists call a genetic bottleneck—the few panthers that are left are inbreeding, and they lack many genes for resistance to disease that would be found in a normal sized population. Wildlife biologists are now considering importing cougars or mountain lions from the western U.S. for interbreeding, but some are concerned that this may irreversibly dilute the panther's genetic identity.

Although panthers have experienced a dramatic decline, the population of bobcats has increased over recent years. Bobcats are smaller, spotted cats that weigh 30 to 40 pounds. Bobcats are better adapted to life in fragmented habitat, and they are sometimes seen on the edges of suburban areas. Biologists estimate that between 20,000 and 40,000 bobcats live in Florida.

Mangroves

Mangroves are a unique type of wetland that occur in coastal areas where freezing temperatures are rare and where waves are weak. Mangrove thickets look like a wicker forest—the trees are thin, and the trunk splits a few feet above the ground into many thin segments that intertwine with other mangrove trees. Mangrove ecosystems are among the most productive known—they serve as a vital breeding and feeding ground for a wide variety of fish, shrimp, and other marine life. Mangroves are most common on the Gulf Coast from Tampa to the south tip of Florida, and can be seen in some places along the Atlantic coast including the Merritt Island Preserve near the Kennedy Space Center.

When the tide goes out and leaves saltwater behind, partial evaporation may concentrate salts and lead to hypersalinity. Mangroves have evolved to handle this stress in different ways. The red mangrove maintains its balance of ions by excluding salt from entering the roots. The black mangrove allows salt to enter through the roots, but then chemically pumps salt out through the leaves. Both of these adaptations are energy intensive, but allow mangroves to flourish in the intertidal zone.

A History of Problems

The settlement of the Everglades began as a small scale, piecemeal effort, and developed into one of the largest water management projects in the world. In the 1850 Swamp and Overflowed Lands Act, the federal government offered the Everglades to the State of Florida, provided they were drained and brought into production. Initially, there were many private, small-scale attempts to drain the glades that failed. Around the turn of the century, momentum to drain the Everglades began to build within the State of Florida. By the time of the Great Depression, more than 400 miles of canals had been built, and these were successful in draining large areas to allow cattle farming and the growth of settlements. By 1980, 1400 miles of canal were operating to drain the Everglades.

In 1926 and 1928, hurricanes hit South Florida. The large amounts of water these hurricanes dumped on the region led to flash flooding and heavy damages to the region around Lake Okeechobee. In response to this, a levee was built around the south rim of Lake Okeechobee. The levy was successful in preventing flooding, but disrupted the natural flow of water into the Everglades.

More than six million people (about 40 percent of Florida's population) live in or around what was once the Everglades, including the cities of Miami, Ft. Lauderdale, Boca Raton, and Orlando. These cities have grown and depleted many local water supplies, and they are now looking for water supplies from farther away, or deeper underground. As wells are pumped dry near the coast, salt water flows underground from the ocean. In many coastal areas, underground water supplies have been ruined by saltwater intrusion. This has increased the demand for surface water from the Everglades.

Agriculture

The Everglades Agricultural Area (EAA) surrounds the southern half of Lake Okeechobee, and occupies nearly 1,100 suare miles (2,849 sq km). Sugar cane occupies more Everglades acreage than any other agricultural acivity, but cattle, citrus, and vegetable farms are also important activities. Agriculture has already taken over the best lands, and is negatively affecting the areas that were left as nature preserves. Three Water Conservation Areas (WCAs) around the EAA were created by dams, levees, and other drainage structures.Although the term Water Conservation Area sounds positive (and the areas were largely protected from agriculture or suburbanization) the WCAs has been last in line when water is scarce.

Agriculture las changed the Everglades in many ways. Farm fields replace natural vegetation, and offer little habitat fir wild animals. Agriculture could not occur in the glades without extensive drainage, which has disrupted all the Everglades. Agriculture involves the use of fertilizers and toxic pesticides, whose effects pread far beyond the field. One of the most studied effects of agriculture on the Everglades has been the *cattail invasion* caused by the runoff of phosphorous and nitrogen from the agricultural regions into the glades. Although phosphorous and nitrogen are naturally occurring chemicals that are essential for plant life, the Everglades evolved to depend on very low levels of these fertilizer compounds. When levels o nitrogen and phosphorous rise, cattails out-compete sawgrass and other native vegetation. Cattails offer lss food and shelter to species of birds that evolved to live in sawgrass.

Sugar Price Supports

Sugar growers in the Everglades benefit from a wide variety of government assistance. The federal government has paid billions of dollars for the drainage and irrigation canals that criss-cross South Florida. A system of price supports, subsidies and import quotas has guaranteed sugar growers a high price for their crop, regardless of the market price of sugar. These price supports were designed after World War II to reduce America's dependency on foreign sugar, but they have been costly to the consumer. On average, Florida sugar producers are able to sell their crop at twice the world market price while the American consumer pays an extra two billion dollars each year for sugar or foods that contain sugar. Although the 1996 Federal Farm Bill removed subsidies for many crops, price supports for sugar were left in place.

Toxic Chemicals

Toxic chemicals represent a serious threat to the ecology of South Florida, especially to animal species at the top of the food chain. Many persistent toxins become biomagnified as they pass through the food chain. The bodies of predators at the top of the food chain may have concentrations of poisons that are ten to one hundred thousand times higher than the general environment. Many Florida panthers, for example, have high levels of mercury, cadmium, and other heavy metals. Alligator populations may have high levels of DDT, PCBs, Dioxins, and other chlorinated hydrocarbons. These chlorine-containing molecules are believed to weaken the immune systems of many animals, and some may cause cancer. Many are estrogen mimics. Estrogen mimics affect the sexual development of both genders, and are believed to be interfering with the alligators' reproduction in some areas.

Exotic Plants

Exotic plant species are plants from distant parts of the world introduced by farmers, gardeners, or accidental plantings. Natural enemies—usually insects, bacteria, or fungi—keep most plants in check over their traditional range. When a plant is introduced to a new area, these checks are often absent. If the plant is adapted to the climate of the new area, its growth may be explosive. In many parts of the Everglades, melaleuca trees and the Brazilian pepper are establishing themselves and changing the ecology. These invasive species crowd out native species, and offer little in the way of food or shelter to wildlife.

Melaleuca was introduced from Australia around the turn of the century for use as an ornamental. The tree produces seed two or three times each year, and releases thousands of seeds that are carried by the wind. There is concern that thick groves of the deep-rooted melaleuca will lower the water table and transform the soil and plant life.

Scientists with the U.S. Department of Agriculture are planning to release two natural insect predators from Australia in an attempt to control melaleuca in Florida. The melaleuca weevil and a species of sawfly are undergoing testing to determine if they are likely to affect other types of vegetation. Although this type of approach is safer than chemical sprays, similar efforts have backfired in the past. The cane toad is one example; it was released in the sugar cane areas in an attempt to control insects. No improvement in sugar yields was noticed, while the toad, which secretes poison from its skin, has become a nuisance in parts of Florida.

Fire

Fire has always been a part of the ecosystem; in recent years, human activity has led to larger fires that are more destructive than in times past. Traditionally, fire was caused by lightning from the storms that marked the end of the dry season to the beginning of the wet season. Because the lightning was accompanied by rain storms, the fires tended to be small and short-lived. Small fires tilt the ecological balance in favor of grasses, as trees are killed by the fire, but grasses rebound by sprouting from their roots.

Recently, humans have replaced lightning as the major cause of fire. Because many human-started fires occur in the beginning or middle of the dry season, they burn longer and hotter. Animals that could escape a small fire become victims of the larger fires. In many parts of the glades, the soil is so rich in organic matter that the soil itself burns. When this happens, the underground portion of grasses is destroyed, and the burned area does not recover rapidly. The loss of organic matter leads to thin, poor soils that cannot support as much vegetation.

Solutions

A number of political and scientific solutions have been proposed for the Everglades. These include restoring the Kissimmee River, restoring or creating wetland buffers, and various plans for partially restoring the natural flow of water. In the 1996 general election, Florida voters were called upon to accept or reject three proposals on the fate of the Everglades.

In the mid-1980s, the U.S. Army Corps of Engineers (which is responsible for most large-scale water projects in the U.S.) decided to restore the Kissimmee River. This involves changing a 53 mile (85 km) straight-line canal back into a 100 mile (161 km) meandering river. The Corps of Engineers literally dusted off the plans for creating the canal to undo their earlier work.

The South Florida Water Management District has been considering the purchase of large buffer zones around the Everglades Agricultural District. Specially designed wetlands would be placed in the zones to filter the water flowing into the natural regions of the Everglades. Plants and microbes in the wetlands would remove most of the phosphorous, nitrogen, and other fertilizer materials. The managed wetlands would also act as a buffer to even out the flow of water to the natural everglades, helping to approximate the cycles that occurred before human intervention.

The Save Our Everglades Coalition placed three proposals on the 1996 election ballot to amend the constitution. After one of the most expensive political contests in the history of Florida, the voters sent a mixed victory to the supporters of the Everglades.

Proposition 4 proposed that the State of Florida charge one cent per pound of sugar to pay for environmental restoration. Proposition 5, called the "make the polluter pay" provision, proposed that the state constitution would hold the polluter legally responsible for the costs of any clean up or environmental remediation. Proposition 6 proposed creating a trust fund for protecting the environment, although it did not guarantee that any funds would be allocated to the fund.

Proposition 4 was the most controversial, as it would immediately cost the sugar growers millions of dollars. Although initial polls showed that the measure had widespread support, it was defeated on election day. Opponents to Proposition 4 capitalized on anti-tax sentiment in Florida, and their ads implied that homeowners would pay more taxes (though they would not). The opponents also played on anti-government sentiment by portraying the South Florida Water Management District (the state agency that would receive the money) as an inefficient, wasteful bureaucracy. Proposition 4 was portrayed as a measure that would cost jobs, although pollution of the Everglades is already affecting jobs in tourism and fishing. Continued pollution of the South Florida water supply may eventually cost billions more, and will eliminate more jobs in Ft. Lauderdale or Miami than could be saved in the Belle Glade farming region.

The Florida electorate approved both Propositions 5 and 6. Although the trust fund created by Proposition 6 may or may not be adequately funded in the future, a mechanism is in place to assist the restoration. Proposition 5 could cost the sugar growers more than the defeated one cent per pound tax if the State of Florida vigorously pursues the issue in the courts.

Conclusions

The Everglades is a unique ecosystem that faces a host of problems including an increasing population, diversion of water, loss of habitat, and chemical pollution. The environmental problems that South Florida faces will be difficult, but not impossible to solve.

Geographers are working with biologists, chemists, planners, and other scientists to understand the myriad of problems and propose solutions. Geography is uniquely interdisciplinary, and offers many possibilities for integrating highly specialized work into a comprehensive, holistic endeavor. Education is increasing the public's awareness of the Everglades and is creating a climate where remedial action can and must be taken.

Internet Resources

More information about the Everglades can be found on the Internet through the *Florida Environment @ Jacksonville University.* The URL address is: http://www.junis.edu/HomePages/environment/

9

Geomorphology of the Rivers of Peninsular Florida

Joann Mossa

Florida's rivers, particularly those on the peninsula, differ from most other rivers described in geography textbooks for North America. Most of the rivers of which you are likely to be familiar such as the great Mississippi are alluvial; that is they are created by runoff from rainfall and flow upon sediment deposited in the stream channel (alluvium). Alluvial rivers also overflow their banks, usually once a year, covering their floodplains with water.

Much of the central portion of the Florida peninsula is karst terrain, and this makes for some very interesting conditions as far as rivers are concerned. Karst topography is created by the dissolution by groundwater of limestone and other carbonate rocks underlying the land surface. Under the surface is a complex world of tubes, tunnels, great open chambers, chimneys, and streams. Sometimes the roofs of these underground structures collapse producing sinkholes. On May 8, 1981, a giant sinkhole developed in Winter Park, just north of Orlando, swallowing a parking lot, several cars, and a portion of a swimming pool. The term karst comes from the Dalmatian coast of the former Yugoslavia where similar conditions occur. Other karst areas in the world include portions of Kentucky, the Yucatan peninsula, parts of Cuba and Puerto Rico, and southern China and western Malaysia.

What kinds of rivers would you expect to find in a region of karst terrain, low relief, and abundant rainfall like peninsular Florida? Many rivers are spring-fed, for example the Wakulla River south of Tallahassee and the Silver River near Ocala. Some rivers disappear underground and reemerge. The Alapaha River, a tributary to the Suwannee River, flows through a mature karst terrain of numerous sinkholes, stream sinks, and sinks. The entire river flows underground through solution channels in the limestone before emerging at two springs—Alapaha Rise and Holton Springs. The Santa Fe River also disappears underground at O'Leno State Park in Columbia County, re-emerging 3 miles (4.8 km) downstream at Santa Fe Rise. Other peninsular rivers derive, at least their initial flow from wetlands or lakes. The St. Johns, the longest river in Florida, flows north from a complex of marshes, and the Suwannee originates in the Okefenokee Swamp in Georgia. The Everglades, aptly called the "river of grass" by Marjory Stoneman Douglas and Pa-hay-okee or "grassy water" by Native Americans, has a very low gradient of 1 cm per km or a little more than an inch in [illegible] miles (Kushlan 1991). It occasionally received overflow from Lake Okeechobee, which created wide and shallow sloughs through the marsh. The Oklawaha in central Florida originates in a chain of lakes and flows northward to its confluence with the St. Johns River (Figure 9.1).

You will have a chance to visit Lake Apopka, one of the Oklawaha's headwater lakes. Lake Apopka has been severely polluted, primarily from agricultural runoff. The St. Johns Water Management District has begun a long and expensive process of restoration. You may also visit the Wekiva River, a spring-fed tributary to the St. Johns, still largely in its natural state. The Wekiva basin, although only 20 minutes from Orlando, is home to black bears and alligators as well as Sherman fox squirrels, sandhill cranes, bald eagles, and deer.

Humans have modified many of the rivers of peninsular Florida for navigation and drainage. Notable examples include the Cross Florida Barge Canal and the channelization of the Kissimmee River. The Cross Florida Barge Canal, first proposed in 1826, was never completed. The channelization of the Kissimmee, known as C-38, was completed in 1971, but now largely because of negative environmental effects is in part being restored to natural conditions. From these costly mistakes, Floridians have learned of environmental problems caused by dredging, channelization, reservoir construction, and other human modifications. Throughout much of South Florida, wetlands, including portions of the Everglades, were drained for agriculture and cities and suburbs. Today in South Florida competition is intense for freshwater and resource managers must balance the needs of agriculture, public supply, and natural systems.

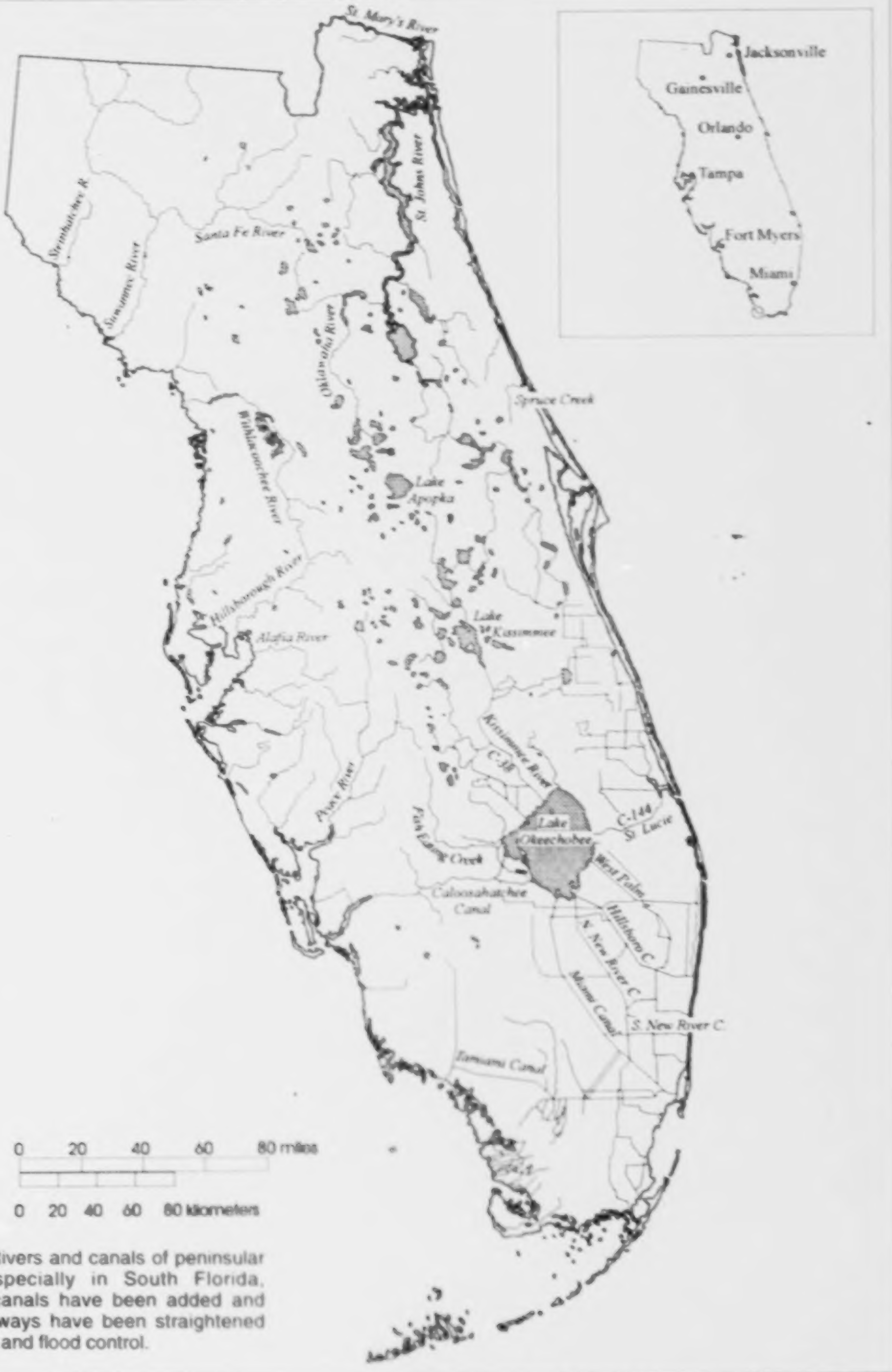

Figure 9.1: Rivers and canals of peninsular Florida. Especially in South Florida, numerous canals have been added and other waterways have been straightened for drainage and flood control.

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Increasingly in Florida as well as in the rest of the nation people are recognizing the freshwater needs of natural systems.

Geographical Investigations of Rivers

Rivers have always been of interest to geographers. They are an integral part of the physical and human landscape, and are critical to human civilization because they provide freshwater, sediment, and biologic resources, and often constitute corridors of settlement, industry, navigation, and agriculture. They are also physical barriers and frequently delineate one political entity from another.

One of the more important topics of geographic investigation is flooding. The occurrence of floods is well known as part of the natural cycle of many rivers, yet human occupancy in floodplains has increased in many parts of the United States, resulting in tremendous personal hardships and economic loses. Structural approaches such as levees, dikes, and dams are often used for flood protection, yet in numerous cases, such as the Mississippi River flood (especially in Iowa, Missouri, Illinois) in the summer of 1993, and the Red River of the North flood (in North Dakota and Canada) in the spring of 1997, such structural measures failed and homeowners and taxpayers suffered financially and were seriously inconvenienced for weeks. For this reason and others, nonstructural measures such as land acquisition, local regulation, research, and public education are gaining popularity. In Florida several state programs as well as local programs are in place to buy floodplain lands to provide a buffer for the river and minimize future damages by reducing the amount of land available for development in the floodplain. Using Geographic Information Systems (GIS) or computer systems for storing and analyzing geographic data, geographers can help decide the priorities for land acquisition with limited funds based on location and sizes of properties and willingness to sell. Land acquisition in floodplains also preserves endangered lands and habitats, helps ensure water quality and quantity, and adds open space for public use.

Geographers also study *river instability*. Changes in river form and channel position are investigated using historic maps, aerial photographs, and bathymetric surveys (depth surveys), as well as stream flow and river stage measurements. The U.S. Geologic Survey measures stream flow and river stage on rivers throughout the United States. River instability results in erosion and sometimes property disputes. Changes of the channel bottom resulting in removal of sediments or scour can undermine bridges, dams and other structures; addition of sediments or fill can increase flood hazards or increase dredging costs for navigation by reducing the channel capacity. Human activities such as agriculture and silviculture (commercial growing of trees) often increase sediment supply, which in turn increases instability of river systems and affects aquatic plants and animals in various ways. Effects to plants and animals include burial, clogging gills, creating an unstable habitat, decreasing the area for burrowing, reducing the light for photosynthesis, interfering with reproduction, and introducing contaminants.

Natural Characteristics Of Florida's Rivers

The Florida peninsula is composed of both clastic (rock fragments produced by weathering of a larger rock mass) and carbonate sediments (produced by microscopic shells and shell fragments) and sedimentary rocks. These are exclusively Quaternary (present to 2 million years old) and Tertiary (2 to 65 million years, which is fairly young compared with much of the remainder of the United States. Because peninsular Florida is low, the rivers have low gradients and thus low energy.

Most large rivers in the United States are alluvial, fed primarily by rainfall and carrying loads of sediment. Most rivers in peninsular Florida, however, are not alluvial but are karst rivers, being formed in carbonate sedimentary rocks, where considerable interaction occurs between groundwater and surface water. These often have a substantial alluvial veneer of sand, muck, or other sedimentary materials. Karst rivers are given little attention in the literature of physical geography because it is unusual to have appreciable surface water in karst terrain. Florida because of its high rainfall (an average of 57 inches or 1248 mm each year), high water table, and proximity to sea level is an exception.

River Classification in Florida

Several systems have been used for categorizing Florida rivers, developed primarily by ecologists (Nordlie 1990). Beck (1965) developed the most commonly used classification of Florida waterways. It includes five categories: sand bottomed streams, calcareous streams, swamp-and-bog streams, large rivers, and canals. Although this classification describes some of the major characteristics of rivers in Florida, it is not without problems, specifically because it mixes various criteria, such as bed or bottom and bank materials with size and human modification. Some combination of adjectives is more appropriate, such as large, sand-bottomed streams or large, calcareous streams. Using a single adjective also is inadequate to describe rivers that vary from the headwaters to the mouth as many Florida rivers do. As they cross differing geological units, the bottom or bed materials may change from sandy to calcareous. Finally, this classification does not recognize that differing bed and bank materials may occur at a single cross section, as a number of calcareous rivers have a thin-to-thick veneer of clastic sediment (usually sand) overlying the limestone.

Drainage and Channels of Peninsular Florida

Drainage patterns of karst landscapes such as peninsular Florida are often characterized as deranged, because the surficial drainage may disappear underground at numerous local pits and depressions. It may then reappear in a different surface water basin.

Karst rivers may have large lakes or large depressions along their courses. The St. Johns and Kissimmee rivers are examples (Figure 9.1). Channel offsets are a drainage feature, which are in part created and maintained by karst processes. The St. Johns River has an offset course, where the river initially turns to the west to reach a valley cut in older, higher terrain, then flows northward for about 120 km (75 mi), and then jogs back to the east to traverse a younger, lower surface (Pirkle 1971). It is believed that this offset course is part of the valley of an earlier river (Pirkle 1971).

Sinks and springs of varying sizes are numerous in peninsular Florida, largely associated with the presence of carbonate rocks. Some rivers, such as the Silver and Ichetucknee rivers in northern Florida, which are dominantly spring-fed are popular for water recreation because of the crystal clear waters. Numerous small rivers, and some moderate-sized ones as well, have well-developed sinks that cause the river to disappear underground and springs that cause it to reemerge some distance downstream. One of the larger rivers that is diverted underground is the Santa Fe River, located near High Springs in north-central Florida. This river is diverted underground at O'Leno Sink and then resurfaces about 5 km (3 mi) to the south at the Santa Fe River Rise (Skirvin 1962). Studies with chemical tracers have found that the underground channel connects with or intersects several wetland lakes between these points (Ellins *et al.* 1991). Cave divers that have examined sinks in this river and others in north-central Florida have found a well-developed multi-channel cave underground network, known as an anastomotic pattern.

In the karst rivers of peninsular Florida, groundwater input or baseflow contributes appreciably to stream flow. Because there is less direct runoff, it may take several weeks to months for floods to rise and fall, generally allowing ample time for evacuation. Surface water-groundwater interactions are often bidirectional. Often during droughts, springs continue to provide flow to rivers. During floods, springs may also become sinks sucking water into the aquifer and decreasing the amount of surface flooding. Compared to elsewhere in the United States, in peninsular Florida suspended sediment is low because there are not abundant fine sediments. Bed load (material moving on or immediately above the stream bed by rolling, jumping, and sliding) has not been studied in detail, but is likely low because of the nature of the flow characteristics (slow velocities, low gradients). Thus, the transported materials are dominantly dissolved materials.

In most alluvial rivers and rivers traversing a long distance, the terrain of the headwaters is steep and the profile becomes gentle approaching its ultimate destination. In areas of resistant bedrock, stream profiles may be linear or have knickpoints, or inflection points reflecting changes in slope, such as waterfalls or rapids. Some of the karst rivers of Florida, such as the Suwannee River in north-central Florida, differ considerably from rivers described in textbooks. In the Suwannee River where bed material changes from clastic sediments to older limestone (Crane 1986), bed elevation and water surface profiles show a locally steep knickpoint known as Big Shoals (U.S. Army Engineer District Jacksonville, 1974) (Figure 9.2). Crossing this knickpoint, the bed gradient changes, the bottom topography becomes more irregular, and water depths increase. Such irregularities are associated with springs and sinks are not generally described in textbooks.

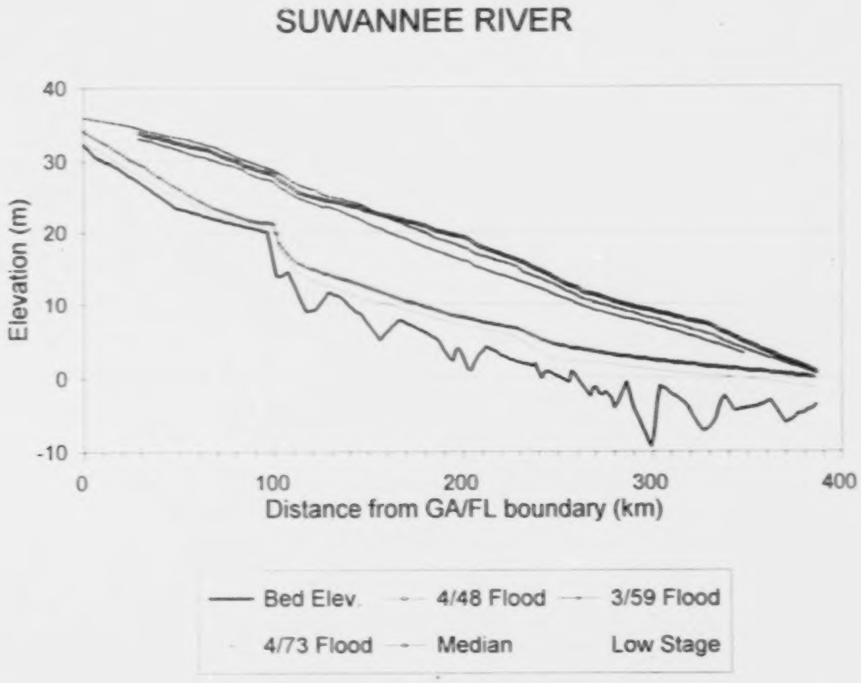

Figure 9.2: Longitudinal profile of the Suwannee River, a large karst river in peninsular Florida. Major features of the profile include a knickpoint known as Big Shoals that occurs near km-290, and numerous depressions marking sinks and springs where limestone occurs at or near the channel bottom.
Source of data: U.S. Army Engineer District-Jacksonville 1974.

Human Modifications of Rivers and Waterways in Peninsular Florida

Humans have modified rivers in Florida for centuries, if not millennia, although their consequences have been particularly severe within this past century. In southwestern Florida, hundreds of years before the arrival of Europeans, the Calusa Indians modified waterways and built an extensive network of canals (Leur 1995).

Deforestation, urbanization, agriculture, land drainage, and flood protection all affect rivers. Modifications along the channel and floodplain, such as dams and weirs, channelization, dredging, floodplain and in-channel mining, removal of bank vegetation, and structures such as bridge and pipeline crossings generally have more direct and severe effects on the channel form and process. Deforestation, agriculture, and urbanization generally aggravate flooding. Although the potential effects of these activities are widely known, not all communities are prepared to deal with these them. In Florida, in contrast with many other states, new developments are required to build retention and detention ponds to decrease and slow surface runoff.

Although several planning and preventive measures have been adopted, flooding still occurs in some areas on the peninsula. Some of these problem areas include Black Creek near Middleburg in northeastern Florida, which has experienced several floods within the last few decades, low-lying agricultural areas near Homestead in Dade County in South Florida, the Suwannee and Santa Fe River floodplains, and a number of other locations. Although some of the prior floods on the Suwannee River were more severe in the acreage of land inundated, several times more damages occurred 1973 ($8 million) than the prior flood in 1948 (U.S. Army Corps of Engineers 1974), in part because of increased floodplain development.

The state of Florida has taken an active role in conservation and preservation through land acquisition. The state has acquired sensitive river floodplains, as well as coastal wetlands. The state and its five water management districts are using Geographical Information Systems (GIS) to evaluate potential land purchases. Comprehensive plans are required at state and local level for growth management, and although plans often change or are sometimes ignored, Florida is better off than many other states that have made limited efforts in this regard.

Canals have been constructed in a number of places throughout peninsular Florida, especially the lowlands of South Florida in areas of urban and agricultural development. They have been constructed for a multitude of reasons, including flood control, water supply, navigation, wetlands drainage, and for some control of water flow directions and elevations. Canalization results in either the straightening, widening, or deepening of an existing waterway or in the construction of a new waterway. Examples of canalization are so numerous, that canals are included in Beck's (1965) classification of Florida's waterways. Eight major waterways, including the Caloosahatchee and Kissimmee rivers, which have remnant channels now comprising the floodplain, and the Tamiami, Miami, North New River, Hillsboro, West Palm Beach, and St. Lucie Canals, are classified as such. Furthermore, an extensive set of canals are numbered rather than named. This extensive building of canals has led Palmer (1984) to characterize south Florida as the "quintessence of surface water manipulation." In addition, portions of numerous waterways have been straightened, deepened or widened for navigation through artificial cutoffs and dredging. Blount Island on the St. Johns River is one of the larger artificial cutoffs, and several occur on the Caloosahatchee River and Upper St. Johns River as well.

Three areas of considerable modification in peninsular Florida include the partially completed Cross Florida Barge Canal (St. Johns to southern Withlacoochee), the Kissimmee River basin, and the canal network in Dade County. These case studies show environmental problems that occur with modification of waterways, and suggest that such activities have historically had more negative consequences than benefits. Because of the sensitivity of riverine ecosystems, considerable prudence is necessary prior to construction of water modification projects as serious environmental consequences often result.

Cross-Florida Barge Canal

The partial construction of the Cross-Florida Barge Canal, which was to have connected the east and west coast via the Withlacoochee, Oklawaha, and St. Johns rivers, modified a number of Florida waterways (Figure 9.3). Predecessors to this aborted project were first initiated in 1850 (Huber and Heaney 1984). It was first halted in 1862 because of the Civil War, but resumed for a short time in 1935 and 1936. Work recommenced in the 1964 with construction of major dams and locks on the Oklawaha and Withlacoochee rivers. Construction was again halted in 1971, largely because of environmental opposition.

Considerable controversy exists on whether the modified system should be retained, whether the original conditions should be restored as best possible, or whether a compromise involving partial restoration should be attempted. The Rodman Dam on the Oklawaha River represents part of this controversy (Shuman 1995) (Figure 9.3). Most environmentalists believe it should be removed for a number of reasons. Construction of the project initially resulted in destruction of much bottomland forest. By changing the hydrology, it is believed that the dam reduces productivity in the St. Johns River. The dam also is harmful to migratory aquatic species, especially manatee which are often killed at Rodman Dam and Buckman Lock, structures that block passage and reduce habitat of these and other species. In warm and nutrient-rich waters of the reservoir, aquatic weeds and algae have flourished, requiring the use of mechanical and chemical treatments to control undesirable water plants. Additionally, maintaining the structure has an annual cost which over a period of years exceeds the one-time cost of destruction. Many local fishermen and a powerful legislator, however, want it left in place because it has become a favorite spot for bass, and the fish and bird populations now accustomed to the dam would undergo a period of stress.

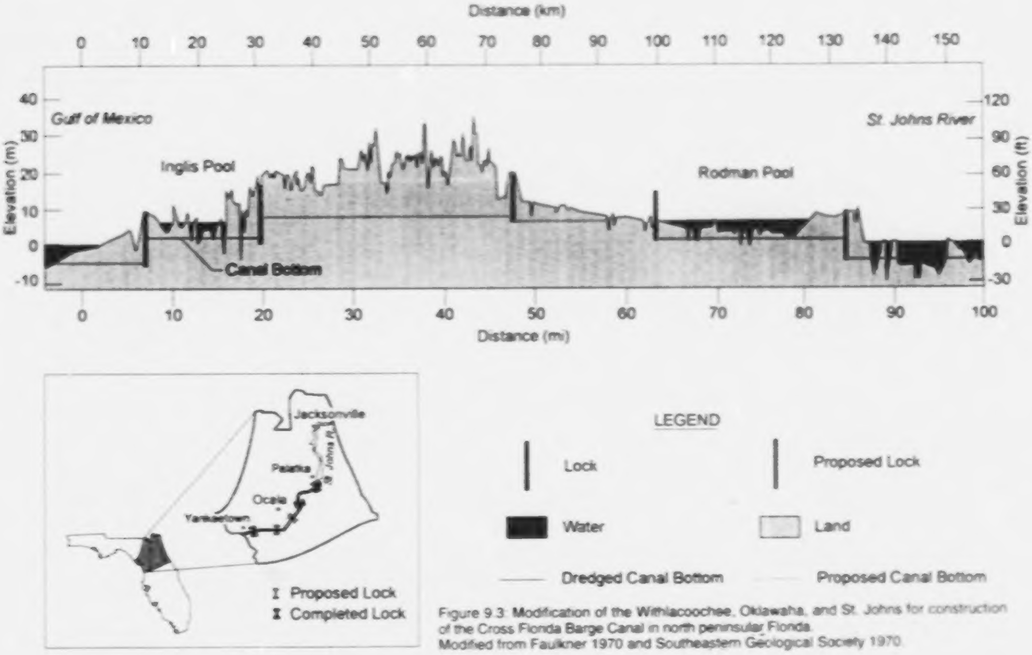

Figure 9.3: Modification of the Withlacoochee, Oklawaha, and St. Johns for construction of the Cross Florida Barge Canal in north peninsular Florida.
Modified from Faulkner 1970 and Southeastern Geological Society 1970.

The Kissimmee River or C-38

The Kissimmee River is located in south-central peninsular Florida, flowing about 166 km (103 mi) from Lake Kissimmee to Lake Okeechobee (Figure 9.4). Congress authorized the Kissimmee River Flood Control Project in 1954, and it was constructed between 1962 and 1971 at a cost of $32 million (Pilkey and Dixon 1996). The project diverted flow from the 166 km (103 mi) of meandering river channel and a 1.5 to 3 km-wide (.93 to 1.9 mi-) floodplain to an excavated 90 km long, 64-105 km wide, 9 m deep (56 mi-long, 209 to 344 ft-wide, and 30 ft-deep) canal named C-38 (U.S. Army Corps of Engineers,1985).

Included in the project were six water flow control structures with tieback levees and navigation locks, designed to allow passage of small boats. These maintain stable water levels in five stair-step impoundments or "pools" along the canal's length. Although remnants of the former river channel remain on either side of the canal, the flowing river ecosystem has essentially been replaced by a series of relatively stagnant reservoirs with a central deep canal (Toth *et al*. 1993). Inflows to C-38 occur through the uppermost structure and are regulated by a flood control operation schedule that was implemented in the Kissimmee's headwater lakes.

Loss of wetlands and water quality problems were anticipated, but the project went ahead anyway (Pilkey and Dixon 1996). The drainage of 200,000 acres (78,740 ha) of floodplain wetlands caused a decline in water quality, water birds, commercially valuable fish species, and wildlife habitat. In the absence of flow, thick deposits of organic matter accumulated on the bottom of the remaining river channel and reduced depth and substrate diversity within these stagnant, remnant river courses (Toth 1993; Toth *et al*. 1993). One year after the canal's completion, there was much opposition calling for river restoration. In 1991, under a congressional mandate, the Corps began restoring about one-third of C-38, which will cost $400 million, more than ten times as much as the entire original project (Pilkey and Dixon 1996). Little is known about appropriate strategies for river restoration since such efforts have only been attempted quite recently, so it is unknown how successful these efforts will be. An increasing number of individuals are committed to seeking alternatives to river modification, such as land acquisition and other approaches.

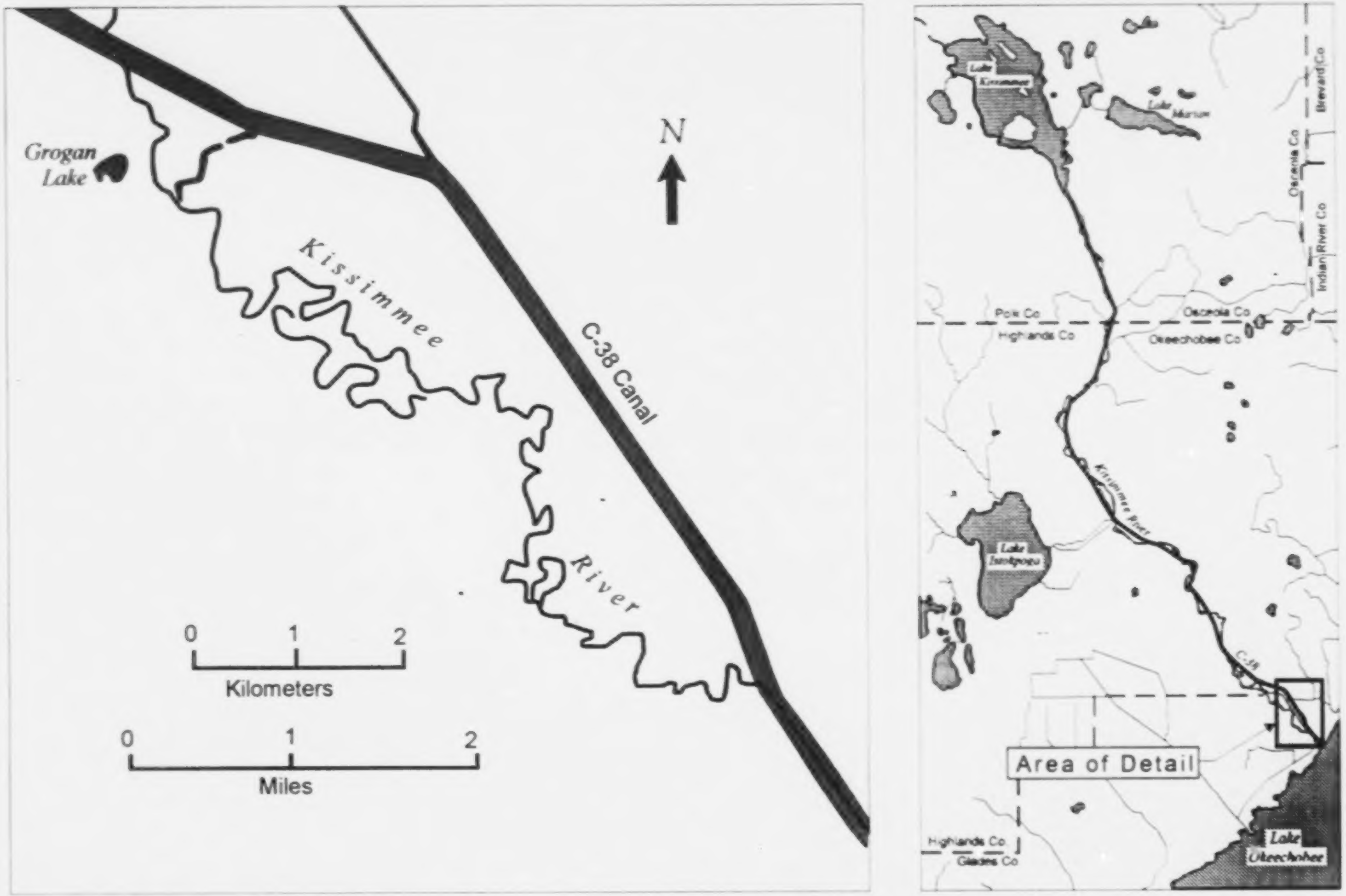

Figure 9.4: Channelization of the Kissimmee River in southern peninsular Florida has produced a canal named C-38, which is presently being partially restored. The southernmost portion of the river and canal are shown in detail.

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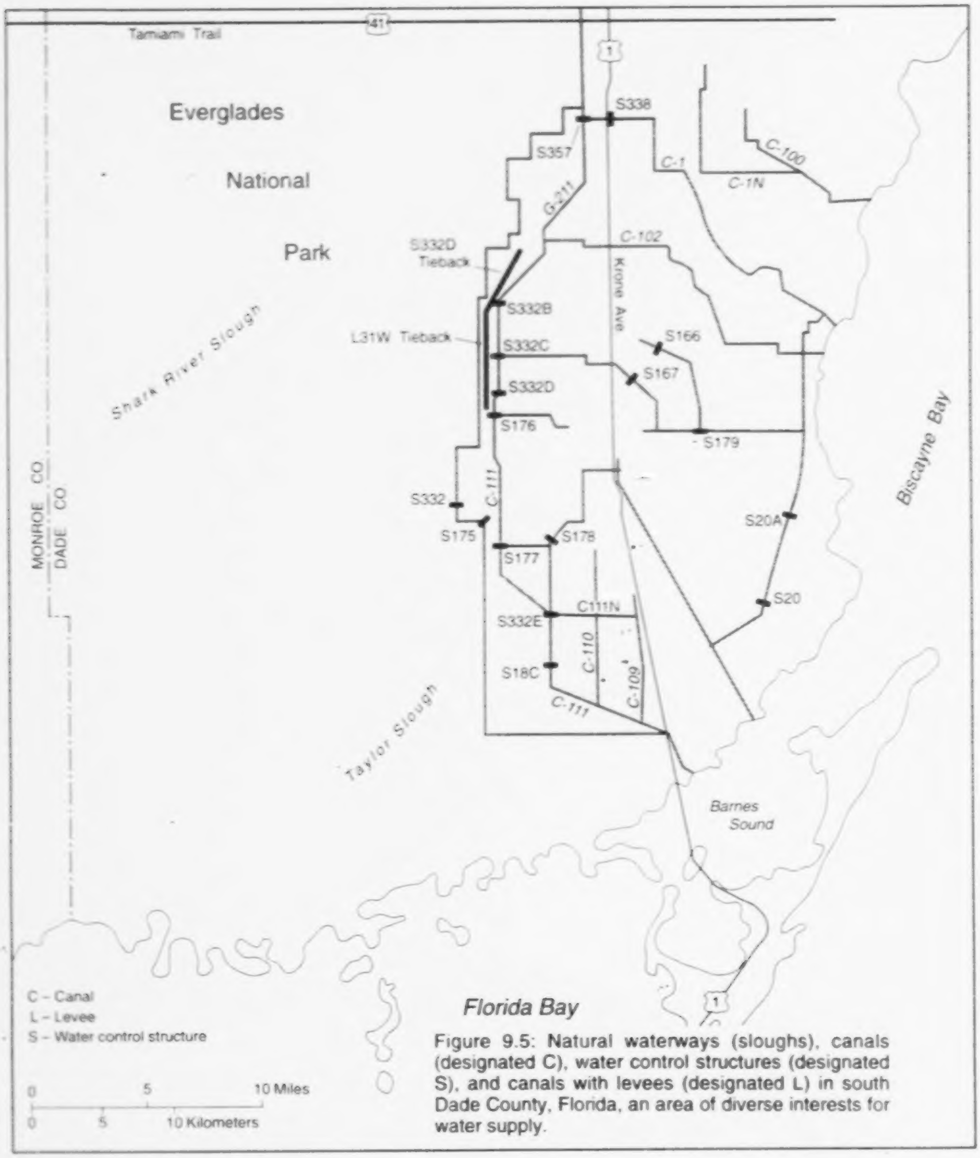

Figure 9.5: Natural waterways (sloughs), canals (designated C), water control structures (designated S), and canals with levees (designated L) in south Dade County, Florida, an area of diverse interests for water supply.

Canals and Water Management in Dade County, Florida

Since the early part of the century, wetlands have been drained throughout much of South Florida, including southern Dade County, to promote agriculture and development. The extreme eastern end of this area is urban, the western end includes Everglades National Park, and the central portion is dominated by agriculture. Because of the diverse needs of cities, agriculture, fisheries, tourism, and natural systems, this low-lying area has been difficult to manage, particularly during hydrologic extremes such as floods and droughts. The natural waterways in this area are not quite rivers but two wide and shallow depressions, Taylor and Shark River sloughs, which generally drain toward the southwest toward Everglades National Park (Figure 9.5). A conveyance system was authorized in 1968 to improve water supply to south Dade County. Since congressional approval of this conveyance system, a progressive increase in the length of human-created waterways has occurred, namely several canals, structures, and canals with levees designed to manage the minimum and maximum amounts of water across the region (Figure 9.5). More recently, because of habitat destruction and declines in the biological quality of Everglades National Park and Florida Bay, efforts have been made to restore this part of Florida

In 1983 then-governor Bob Graham announced a program, Save Our Everglades, and established an ambitious goal: "By the Year 2000, the Everglades will be more like it was in the year 1900 than it is today." In 1994 the Florida Legislature passed the Everglades Forever Act setting forth a detailed plan to restore the Everglades. Although early results of restoration efforts are promising, satisfying all parties in this unique, yet highly modified, region will be difficult.

Summary and Conclusions

Florida is one of the few places in the world where large rivers occur in carbonate sediments. These rivers have been important to humans for millennia, but within the last century they have been appreciably modified by human activities. Although much effort has been expended in some areas to minimize the effects of human activities in Florida, elsewhere these modifications have resulted in considerable environmental deterioration. Because of their importance to society, further understanding of the rivers and their geomorphology will be useful to resource management and planning.

Acknowledgment

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10

Coastal Geography of Central Atlantic Florida

Heidi Lannon and Joann Mossa

Who can think of Florida without thinking of the coast? The beach and Florida are as intrinsically linked as bayous and Louisiana, and the Rockies and Colorado. Sometimes our stereotypes of states are incorrect, but the coastline of Florida has been crucial to the State's livelihood. From fishing to tourism, and commerce to wildlife, the coast has played an important role in the history of Florida. Also, the coast and ocean have played an important role in the geologic history of Florida, which has experienced submergence and emergence throughout much of recent geologic time.

The coastline of Florida varies from narrow sandy spits to coral reefs, and from remote wildlife sanctuaries to thriving urban areas. Florida's wide continental shelf, sediment supply and wave energy contribute to a coastline fringed with barrier islands and tidal inlets. The area inland of the barrier island, is composed of tidal lagoons, linked together, and deepened by dredging to form a navigable route, the Intracoastal Waterway, around the entire state. Other than the Big Bend area, which has low-wave energy because of its wide continental shelf, watercraft can travel in protected waters around the peninsula from Perdido Bay in the northwest to Amelia Island in the northeast (Figure 10.1).

In the United States 75 percent of the population live within one hour's drive of the coast, and in Florida 80 percent of the population live in the coastal counties (Finkl 1996). The coastline of Florida is the longest in the coterminous United States. It is 1900 kilometers (1178 mi) long, without the Florida Keys, and more than 25 percent of the sandy shores in the United States are located in Florida (Morgan and Stone 1985).

Beaches and sand dunes are vital for tourism and recreation in Florida. These areas are also vital for dissipation of wave energy, protection from coastal storms, and storage of sediments. This chapter will introduce the reader to the coastal environment, dividing the discussion into the physical and human landscape. The Brevard County coastline is the local study site that will be used to illustrate coastal issues.

- The physical characteristics described will include the description of barrier islands, sand dunes and estuaries. An explanation of the important processes affecting the coastal environment, such as waves, tides, storms, and sea level changes follows.
- The section on Human Interaction with the Coast will describe the Brevard County local economy and its relationship with the coast. It will also illustrate the importance of beach renourishment for tourism, the effects of the space industry, and coastal construction limitations.

It is impossible to separate completely coastal processes and human interactions with the coast. Hurricanes and storms, for example, are described as physical processes in the coastal system. The effect of hurricanes and storms on the coastal population is also important and discussed in terms of human responses. This chapter will describe, therefore, the physical processes and systems of the coastline, and then attempt to put them in the context of the human environment of Brevard County.

Brevard County Coastal Area

The coastline of Brevard County is the site for a detailed analysis of coastal features and associated human interactions. The major urban areas in coastal Brevard County are Cape Canaveral, Cocoa Beach, and Melbourne. The study area has 96.5 kilometers (60 mi) of coastline, excluding the lagoon shorelines. Forty percent of the coast is under Federal jurisdiction. The Federal lands include the Kennedy Space Center, Canaveral Air Force station, the Merritt Island National Wildlife Refuge, Cape Canaveral National Seashore, and Patrick Air Force Base.

The Brevard coastline is fringed with barrier islands that vary in width from less than 100 meters (328 ft) in the south, to 8 kilometers (almost 5 mi) at Cape Canaveral. The elevation varies from 3 to 4 meters(10-13 ft) with an 8 meter (26 ft) maximum. A barrier island is a linear island of sediment, parallel to the coast and

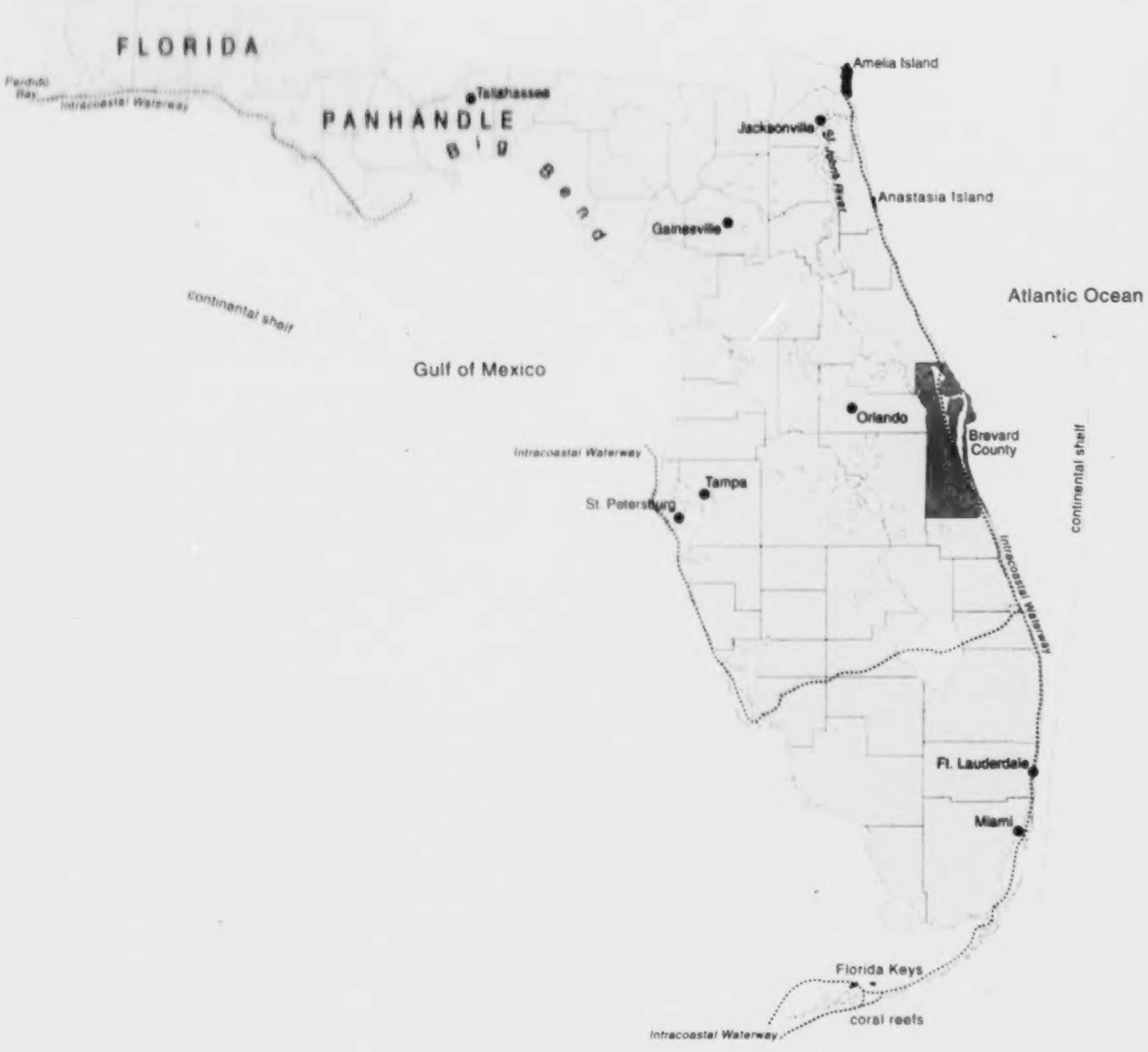

Figure 10.1: The Coastline, showing Brevard County

separated from the mainland by a lagoon. Barrier islands that are developed are usually connected to the mainland by a causeway or bridge. Seven causeways connect the coastal barriers to the mainland in Brevard County. Three lagoon systems are—the Indian River Lagoon, Mosquito Lagoon and the Banana River. The Atlantic Coastal ridge delineates Indian River Lagoon system watershed. Drainage canals have modified the system since the early 1900s. The islands in the lagoon system are both natural and spoil in origin, the latter formed during construction of the causeways.

Figure 10.2 shows the Southeast United States and the location of Brevard County. The variations in wave climate, tidal range and type, sediment size, shoreline change, and sea level along the southeast coast provide a context for detailed discussion of the study area. Figure 10.3 shows the study area in detail, and the four major areas of the Brevard County Coastline with similar characteristics.

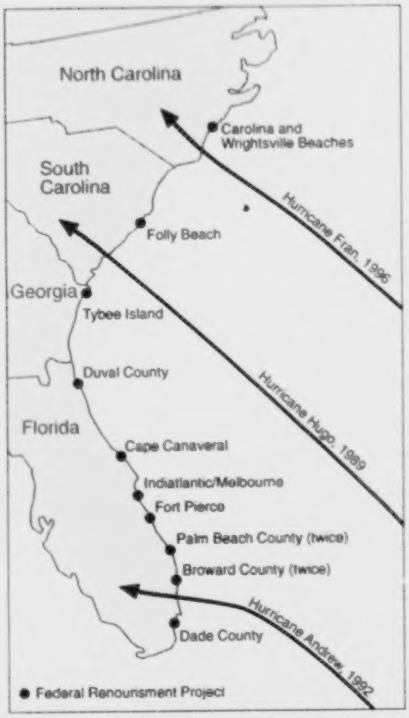

Figure 10.2: Coastal Characteristics and Location of the Local Study Area

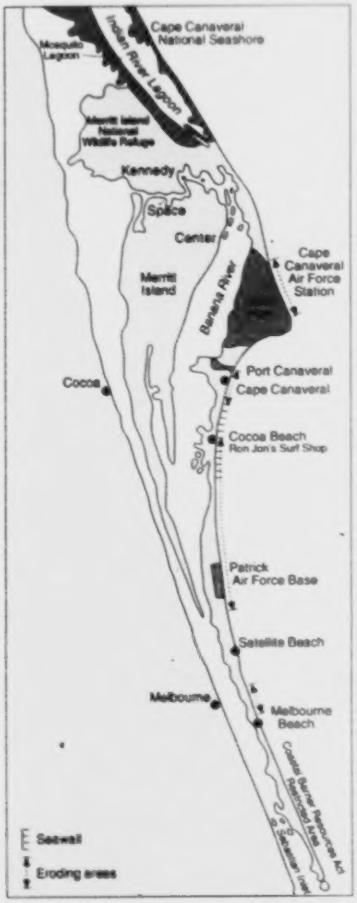

Figure 10.3: Brevard County Coastal Area and Characteristics

- Federal property dominates Northern Brevard County. The National Aeronautics and Space Administration (NASA) controls the 38,115-hectare (168,000-acre) Kennedy Space Center. The U. S. Fish and Game Commission manages the Merritt Island National Wildlife Refuge, and the National Parks Service governs the Cape Canaveral National Seashore. The Cape Canaveral Air Force Station is also in northern Brevard County.

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- Merritt Island is a remnant barrier between the Indian and Banana River lagoons. The area is predominantly residential and agricultural, with 42 percent vacant land. This area is experiencing much conversion from citrus grove cultivation to residential developments.
- The central Brevard County coastal area is composed of the area from Patrick Air Force Base to the north Cocoa Beach and is heavily urbanized. The Canaveral Port Authority has jurisdiction over the 277-hectare (684-acre) port. Little vacant land is available in this area.
- The area south of Patrick Air Force base is heavily urbanized with low to medium density residential and resort developments. South of Melbourne Beach a 1984 Growth Management Directive adopted by Brevard County has kept the area relatively undeveloped with less than 1.5 dwelling units per hectare (less than one per acre). One large citrus grove is in this area. Commercial areas are concentrated along SR A1A, the main highway parallel to the coast.

Physical Processes and Features

Features

Barrier islands are the most dominant features along the Brevard County and adjacent coasts. There are three theories that dominate barrier island formation (Field and Duane 1975).

1. Spit extension: Gilbert (1885) and Fisher (1968) contend that spits, or thin strips of sediment, extend from headlands in the direction of prevailing longshore drift. As sediment is pushed along the coast by wave energy it elongates into splits that eventually become detached. The spits will detach if sediment supply slows or they are breached by storm waves. The detached spits will become vegetated, trapping additional sediment, building dune systems, and stabilizing a barrier island.
2. Emergence: Otvos (1970) favors the notion of emergence of shoals from underwater. He theorizes that shoals forming beneath the water surface cause wave energy to dissipate. The lower wave energy in turn causes deposition of sediments to occur. The sediments will be deposited until they reach the water surface. Some evidence is available that this occurs along the low-wave energy Gulf Coast of Florida, but is unlikely to be responsible in other cases, e.g., Brevard County. High wave energies along the eastern United States, for example, make it difficult to imagine how this process would form barrier islands under those conditions. As Hansen (1993: 16) explains this theory is not currently popular with most coastal scientists, and of Otvos, who he describes as a strong advocate of the emergence theory, he says "These days he is a lonely man."
3. Transgression, or drowning *in situ* (Hoyt 1967): The hypothesis is that coastal ridges or sand dunes formed, and were flooded as sea level rose during the post- glacial transgression, when ice caps melted. The ridges of sediment subsequently move onshore as sea level increases with a lagoon behind the sediment feature.

The prevailing theory on barrier island formation is multiple causality or many causes (Schwartz 1971), that may be interrelated. It seems unlikely that any one theory is completely applicable for all conditions. In the case of Brevard County there are two series of barriers. The earlier barrier is the Merritt Island system, which is fronted by the current barrier islands. This series reflects two transgressions of sea level. The Brevard County barrier system, however, is also unusual near the False Cape area, where a clear inflection point change occurs. The barriers in the Brevard County areas have been classified as perched by Tanner (1960). That means that the sediment that is at the surface covers an original barrier from a previous geologic age. Merritt Island is a remnant barrier. It is a barrier island that has an earlier origin than the seaward-most barrier, formed prior to the other barriers, was eroded, and remains as a remnant.

Pilkey and Dixon (1996) identify four conditions that must exist for barrier island formation. These are:

- sea level rise,
- gently sloping coasts,
- a source of sediment, and
- a wave regime suitable for transporting sand.

The favorable factors for barrier island development are present in Florida and explain the dominance of this feature. In Brevard County the coast is gently sloping to the edge of the continental shelf and sea level has fluctuated. These factors, the source of the original sediment for the formation of barrier islands, and the wave regime will be discussed later in this section. The only areas of Florida that do not have barrier islands, are the Florida Keys, and the Big Bend area, which lacks sufficient wave energy and an adequate sediment supply. Barrier island shape and form are an also indicator of wave and tide dynamics, which will be discussed in the coastal processes section.

Estuarine Systems : Estuaries occur where a fluvial or riverine system interacts with the coast. This is an area where fresh and salt water mix and where tidal influences will determine the shape and dynamics of the system. The lagoons, which are incorrectly called rivers in Brevard County, have low currents and small water level changes of less than 10 cm (4 in). Water-level changes are determined by freshwater runoff and wind, and are also affected by the lock at Port Canaveral. Lagoons in Florida are long and narrow. The ratio of lagoon width to barrier island width along the east coast of Florida is much lower than the world average. The world average is 6 to 1 (Tanner 1960) compared to 1.25 to 1 along the Atlantic Florida coast (McBride, 1987).

The Indian and Banana River Lagoon systems contribute to the 2,680 hectares (6,620 acres) of wetlands in Brevard County identified by the 1982 National Wetland Inventory. The system includes natural and spoil originated islands, red, black, and white mangrove colonies, *Spartina alterniflora* dominated salt marshes, worm reefs, and oyster beds. The natural vegetation of the area is also threatened by the non-native Australian Pine, that is colonizing the estuarine areas.

Sand Dunes: Dunes are elevated areas of unconsolidated sediment that are formed and maintained by wind transportation of sand. Dunes need four criteria to form and flourish:

- a sediment source
- strong onshore winds
- a gentle beach gradient
- low humidity and precipitation (which is not necessarily a characteristic of Florida)

Coastal sediments in Florida are composed of quartz and calcium carbonate. The calcium carbonate is from shell fragments and oolite, or granular limestone grains (Johnson and Barbour 1990). On the Atlantic Coast of Florida the amount of shell fragments, derived from coquina, or rock formed from shells, increases towards south Florida. The calcium carbonate volume increases from less than 10 percent in the Jacksonville area, to more than 40 percent in Miami (Giles and Pilkey 1965). The areas of central Atlantic Florida have also been found to have sediment variations. Stapor and May (1982) found that Jacksonville Beach, Anastasia Island, and False Cape, in Brevard County are composed of fine-grained quartz sand, compared to the coarser sand with larger amounts of shell material in the intervening areas.

The source of the coastal sediments is from rivers draining areas above the coastal plain, not local rivers (Giles and Pilkey 1965). Swift (1975) has determined that the sediments were deposited offshore and were transformed during sea level rise, forming the origins of today's beaches and barrier islands. Sand and pebbles come from the erosion of coastal deposits in Virginia and North Carolina (Tanner, 1960). In Brevard County the sediment is quartz and shell fragments. The amount of shell increases from Cape Canaveral to Sebastian Inlet (*Brevard County Comprehensive Plan* 1989).

Brevard County experiences winds strong enough to sustain the coastal dunes. This wind regime is conducive to dune stability. The beach gradient is gentle and suitable for both barrier island formation and dune formation. Florida does not have the low precipitation and humidity traditionally associated with characteristics suitable for dune formation. The characteristic of low precipitation and humidity is important for sand transportation. The wind speeds are adequate to overcome this as a limitation to dune formation and stability. Dunes in Brevard County and throughout Florida have formed as wind transports sand from the beach face inland. Vegetation traps sand by causing the wind speed to drop and deposit the wind blown or aeolian sand movement. In Florida sea oats are present along the coast. Sea oats are protected by law and cannot be removed according to Florida Statutes. The intent of this requirement is to recognize the importance of this hardy dune plant in establishing, and more importantly stabilizing Florida's dune system, which provides the first line of defense from storm and hurricane conditions.

The extent of the dune system in Brevard County varies along the coast. Dunes in the Cape Canaveral National Seashore are well established and up to 4 meters-(13 ft-) high. Farther south, in the Cocoa Beach area, dunes are non-existent and sea walls flank the backshore that prevent sediment transportation or accumulation.

Beach Ridges: The broader barrier islands of the Florida coasts exhibit beach ridges. Beach ridges are a series of parallel dune ridges and swales. Ridges represent progradation seaward or parallel to the coast (Johnson and Barbour 1990) and may be truncated or eroded by more recent events. Four areas exhibit beach ridges on the Florida Gulf coast (Schwartz and Bird 1985) and beach ridges are present on Anastasia Island in St. Johns County and at Cape Canaveral (Stapor and May 1982). Field (1974) estimates that Cape Canaveral beach ridge deposition took place 30,000 to 35,000 years BP.

Processes

The physical processes that affect Brevard County are discussed in terms of magnitude. At the smallest scale waves affect a barrier island's shape and beach characteristics hourly. Tides have a longer term effect and have daily and monthly cycles. Storms and hurricanes have infrequent but potentially catastrophic and major effects on the coast. Finally, sea level rise is a process that has potentially the most profound effect on the coastline. These effects, however, are over the longest time period. A summary of the processes of shoreline changes appears at the end of this section.

Waves: Waves are particularly important in the dynamic system of barrier islands. Waves may accelerate or retard erosion, and waves generated by winter storms or hurricanes will have even greater effects. Waves influence barrier islands by powering longshore drift, or by causing overwash during extreme events. Longshore drift is sediment movement parallel to the shore, powered by energy received from breaking waves. Long thin barrier islands indicate that there is a low tidal range and wave climate, and probably longshore drift. Short, wider islands, such as the islands from Amelia Islands in north Florida to South Carolina, indicate a higher tidal range than the barriers of central and southern Florida.

Schwartz and Bird (1985) describe the surf-zone wave energy in Florida as varying from low, with an average breaker height of 4 cm (about 2 in), to high with an average breaker height of 1 meter (about 3 ft). The average wave height in Brevard County is 80 cm (about 3 ft) at Cape Canaveral (McBride, 1987) and increases towards the south of the study area, with the highest average wave height experienced towards Sebastian Inlet. The effects of waves will be discussed in the shoreline change section.

Tides: Tides are waves of water, moved by the gravitational attraction between the moon and the sun. The proximity of the moon to the earth causes a greater effect on tides than the sun. As the earth rotates, two bulges of water occur, toward and away from the moon. The sun causes the bulges to be greater when the sun and moon align during full and new moons, producing what are called *spring* tides, which represent the highest tidal ranges each month. These occur approximately twice a month, not during the spring season. When the sun and moon are perpendicular to the earth the effect is dampened and causes *neap* tides, which occur during quarter moons. Neap tides have the lowest tidal range each month. Ideally semidiurnal tides would be recognized in all locations. Semidiurnal tides are two high and two low tides every 24 hours and 50 minutes. The interruption of tidal bulges by major continents and the lack of a uniform ocean depth interferes with this ideal. Each specific location will have a tide determined by the geography of the locale.

Tides are crucial to navigation. Areas with high tidal ranges have limited times when ports are accessible. The southeastern United States has medium to low tidal ranges. The tidal effects in the vicinity of inlets are determined by the range. Higher tidal ranges in areas of diurnal tides will facilitate flushing of the lagoon areas. The development of submerged tidal deltas is also affected by tides, with higher tidal ranges causing deltas in the lagoons, and lower tidal ranges, causing shoals offshore (Davis and Hayes 1984).

Tides also influence the effects of tropical and winter storms. A storm hitting the coast at high tide will have more devastating effects than at low tide because waves and storm surge will affect the area further inland. A storm or hurricane occurring at high tide during a full or new moon stage would have the greatest effect on the coast. This is because the high tides would be highest at these moon stages. Any tidal surge and increased wave activity would occur further up the beach and cause more destruction.

The tidal range in the southeastern United States decreases from north the south. The mean tidal range in Georgia and South Carolina is more than 2 meters (c. 6 ft), more than double the range for most of the Florida coast. In Brevard County the tidal range also decreases to the south of the study area. At Cape Canaveral the tidal range is semi-diurnal and approximately 125 cm (c. 4 ft) (Morgan and Stone 1985). In the vicinity of Sebastian Inlet the spring tidal range is 100 cm (c. 3 ft) and the current is 150 cm/second or about 5 ft/second (*Brevard County Comprehensive Plan* 1988). McBride (1987) concurs that the tidal range decreases to the south of Brevard County, but identifies mean tidal ranges from 110 cm (more than 3 ft) at Cape Canaveral to 70 cm (between 2-3 ft) at Sebastian Inlet.

Storms and Hurricanes

The major hurricanes that have struck the Southeastern United States in the last 15 years are Hurricane Hugo in South Carolina during 1989, Hurricane Andrew in Miami in August of 1992, and Hurricane Fran in North Carolina in August of 1996. The tracks of these storms are shown in Figure 10. 2. The coastline is also susceptible to winter or extratropical storms, which are also known as *nor'easters*. Winter storms receive less media attention than hurricanes in Florida, but provide enough power for serious erosion along the coast. It is these same storms that cause coastal erosion and serious snow storms throughout the Northeastern United States.

The barrier island and Merritt Island areas of Brevard county are vulnerable even to low intensity storms. Storm effects include storm surge, rainfall, fresh and saltwater flooding and high winds. Four of the seven causeways are inundated in the event of a 1-3 meter (3-10 ft) surge, typical of a category 1 or 2 hurricane. The problems with evacuation and the effect of storms on the local population will be discussed in the human interactions with the coast section.

Sea Level Changes

Terrestrial Florida exhibits a series of sand ridges in the interior of the state. These are theorized to have origins as ancient barrier islands or spits that flanked ancient coastlines. The Lake Wales ridge runs north-south down the center of the Florida peninsula. Ridges in north central Florida run parallel to this Lake Wales ridge. Using the physiographic and fossil evidence in conjunction with sediment cores, Pirkle *et al.* (1970) concluded that ridges in north central Florida represent beach ridges that formed when the sea level was 30 meters (98 ft) above present-day levels. A summary of research in Pirkle *et al.* (1970) shows that the relative sea level has been between 35 and 70 meters (115-230 ft) above present levels. During the Pleistocene, the most recent geological period, the sea level varied between 10 and 15 meters (34-50 ft) above present levels.

These sea levels are relative. Sea levels were not that high above the Florida land mass. Sea levels are a function of the amount of water available, not held in ice caps, and the position of the land surface. The karst, or eroded limestone platform that underlies Florida has been raised above current and past sea levels (Opdyke *et al.* 1984). Massive global warming and melting of ice caps would have had to occur for sea levels to have risen up to 70 meters (230 ft). Opdyke *et al.* (1984) concluded that the north central area of Florida has risen at least 36 meters (118 ft) since the ridges in north Florida were formed. The origin of this rising of the land mass is thought to be isostatic. Isostatic changes are the uplift of the landmass because of the reduction of its weight on the earth's crust. The limestone underlying Florida is constantly eroded by surface and, more importantly, subsurface waters. The erosion is chemical. Acidic water dissolves the limestone and removes it in solution, decreasing its weight and causing isostatic uplift. The average sea level rise over the last 50 years in Florida is 1 - 2 mm (.04-.08 in) per year (Evans *et. al.* 1985).

Shoreline Changes

Shoreline changes may be ongoing and long term, cyclical or seasonal, or dramatic. Ongoing long term changes in the shoreline may be caused by longshore drift moving sediment along the coast. This process may be cyclical, or when humans intervene in building permanent jetties in inlets. Cyclical changes are often associated with seasons. During the summer months the beachface may appear wider and flatter. During the winter, storms may remove sediment from the beach face to offshore, making it narrower and steeper. If the change is truly cyclical the sediment stored offshore will move back onshore during calmer, constructive wave regimes. This process also reflects prevailing weather, and narrow, steep, profiles may occur during a particularly stormy period. Sediment is subsequently replenished during calmer periods.

Longshore drift moves sand generally southwards along the coast of Florida (Allen 1991; Tanner 1960). Six distinct drift cells have been identified between the St. Johns River and Cape Canaveral (Stapor and May 1982) and sediment exchange between the six cells was characterized as minimal. Breaks in the net direction of longshore drift are usually caused by rocky headlands or large inlets. Stapor (1980) considers the interaction of waves and bathymetry to be the cause of the multi-cell structure of drift. The State of Florida, Department of Environmental Protection determines areas of erosion (Clark 1991). Brevard County has 45.8- of the 65.5- kilometer (28- of the 41-mi) coastline that has been determined to be eroding. The longest stretch of eroding coastline in Brevard County is a heavily urbanized area from Cocoa Beach to Satellite Beach (Clark 1991). This area includes Federal property at Patrick Air Force Base. In Central Brevard County the Cape Canaveral area has also been designated as eroding. Allen's (1991) detailed study on the effects of the revetment to the north of the Canaveral National Seashore, however, has not determined that this area is conclusively eroding.

Human Interaction with the Coast

The human impacts along the coastline of Brevard county are numerous. The local economy is clearly driven by the location at the coast. With a vibrant economy and high population growth, Brevard County is an interesting study of human interaction with the coast. Following is an outline of the local economy and examples of human intervention in the natural system such as shoreline protection measures, stabilization of inlets, and beach renourishment. Also discussed will be the ways in which Brevard County is attempting to manage growth along the coast by considering the effects of storms and hurricanes and coastal construction limitations on the population.

The Local Economy

Five percent of the land in the coastal zone is agricultural, predominantly in citrus crops and cattle. The fertile soils and mild temperatures adjacent to the lagoons make these areas suitable for agriculture. Agriculture is declining in Brevard County as the area urbanizes. Higher, well-drained areas formerly used for cattle are also perfect for residential development. The fertile soils adjacent to lagoons are also highly desirable for residential and commercial development with access to the water. The main seafood yields in the area are calico scallops, rock shrimp, tile fish, blue crab, penaeid shrimp, and hard clams. The 1985 seafood landing value of $22,375,148, however, is declining.

Brevard County has 5.2 percent of registered commercial boats in Florida—the second highest number registered, behind Monroe County. In 1984 the Florida Department of Natural Resources identified 53 marinas in Brevard County, with a total of 2,077 wet slips and 1,223 dry slips. The Brevard County Comprehensive Plan (1988) projects a 52 to 79 percent increase in registered boats in the County by 2005. The boating facilities range from large commercial endeavors to private multi-family slips. The predominance of multi-slip facilities in the last 6 years are related to condominium development amenities.

The space industry dominates the local economy and with an estimated 60 percent of Brevard County's employment reported in space-related industry (*Brevard County Comprehensive Plan* 1988). The National Aeronautic and Space Administration's direct and indirect employment is responsible for more than 32 percent of Brevard County's total employment, and 27 percent is in technology-related industries, such as Harris Corporation. As the County has urbanized, the transition from agriculture and industry to the service sector has occurred. Along the coastline businesses with a coastal flavor have thrived. Port Canaveral is no longer just a commercial port, but the home of the cruise ship industry and large pleasure craft marinas. Cape Canaveral is no longer just a Federal installation, but a tourist destination, offering historic exhibits, space rockets, and views of the latest space shuttle on the launch pad at certain times of the year. Local businesses also reflect the importance of the coast. From Sea Ray Boats to Ron Jon's Surf Shop local industries have thrived using the connection to the coast. Figure 10.4 shows the entrance to Ron Jon's Surf Shop in Cocoa Beach, self proclaimed as the biggest surf shop in the world and open 24 hours a day!

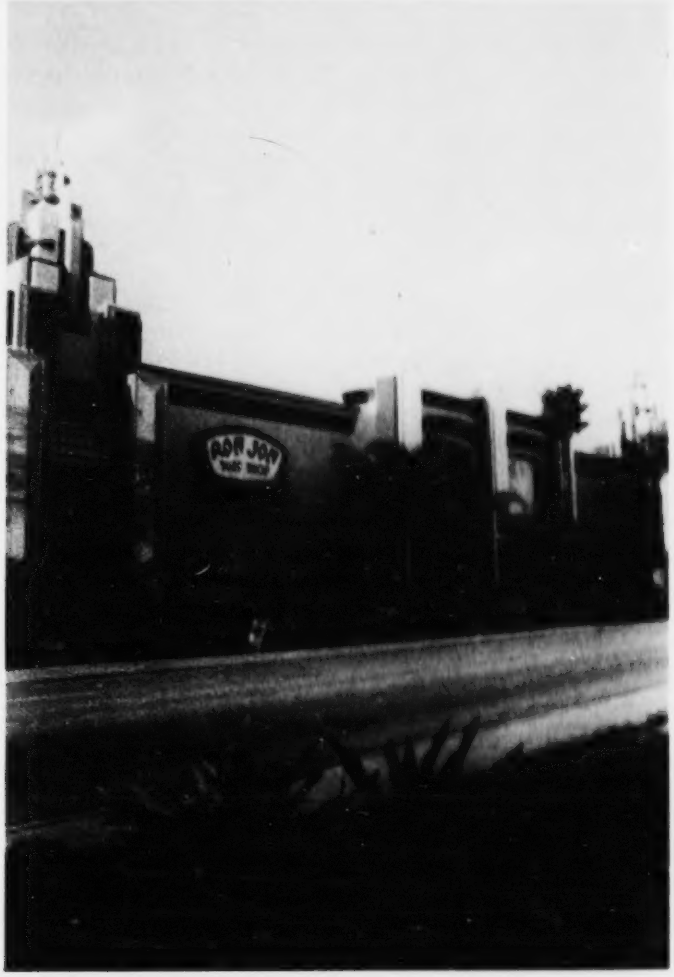

Figure 10.4: The entrance to Ron Jon's surf shop in Cocoa Beach

Shoreline Protection

The coastlines of states throughout the country have become lined with sea walls and other forms of protection against erosion. Florida (if you exclude Alaska) has the longest non-reinforced coastline (Policy and Dioxin 1996). Vertical sea walls have been found to have detrimental effects to the coastline. Sea walls minimize the absorption of wave energy, and may reflect waves causing a scour at the base of the sea wall, which accentuates erosion. A natural beach face will absorb energy using the unconsolidated sediment, and restrict the ability of the foreshore gradient to change. During storm events intensified wave energy causes sediments to be removed (Policy and Dioxin 1996). The dilemma of a dynamic coastline is whether to endure the retreat of the coast, which may be periodic or permanent, or build a sea wall, and risk destruction of the natural beach.

Northern Brevard County has some isolated sea walls and shoreline protection structures. Shoreline protection structures are almost continuous along the City of Cocoa Beach coast. Few structures are south of Cocoa Beach.

Inlets

Inlets in Florida are vital for navigation, especially for the intracoastal waterway. The stabilization of inlets and passes, such as the construction of jetties to fortify the navigational channel, has been a policy for many years, and the consequences are now being identified. The location of tidal inlets will naturally change position over time. Stabilization by building structures not only interferes with the natural migration of the pass but jetties may interfere with the longshore drift of sediments. The classic problematic jetty will cause sediment to accumulate on the updrift side, starving the downdrift areas. The ratio between tidal flow (the flushing ability of the inlet) and the quantity of longshore drift will determine the stability of the inlet position (McBride 1987). Tide dominated inlets, where tidal activity is sufficient to flush the channel of sediment, are much more stable than inlets where sediment accumulation cannot be overcome by tidal currents.

Brevard County has two inlets—Cape Canaveral and Sebastian Inlet. The Port of Cape Canaveral was artificially cut in 1950 and is controlled by a lock. Navigational jetties were added in 1954 (McBride 1987). Sebastian Inlet was also artificially cut in 1924 and closed in 1941 by a winter storm. It was dredged in 1947, and closed in 1948. It was reopened and jettied in 1948 (McBride 1987).

Beach Renourishment

Beach renourishment is the replacement of beach sand that has been eroded with sediment from another source. Florida has several examples of successful and unsuccessful beach renourishment projects and has had the most renourishment projects of all the states (Sudar *et al*. 1995). Beach renourishment or replenishment represents approximately one-third of the federal government's endeavors at reducing coastal erosion (Finkl 1996). Renourishment is important because it reduces the immediate risk of flooding to residents and infrastructures, retains tourism as an important industry, and reduces the future costs of shoreline protection.

Beaches have been renourished in southeast Florida to revive popular tourist destinations. Those in Brevard County are summarized in Table 10.1. Unfortunately, monitoring of the results and long term success or failure of beach renourishments is sporadic, as can be seen from Table 10.1. Atlantic Florida has other examples of nourishment programs. The most expensive renourishment project at Miami Beach cost $82.9 million (Sudar *et al.* 1995). The beach had retreated and the sea walls of adjacent hotels and condominiums line the thin remains of the shore.

Table 10.1: Beach Renourishment Projects in Brevard County

Year	Area	Cubic Meters of Sediment	Sediment Source	Success of Project
1972	Cape Canaveral	152,900	North of Port Area	45 percent in place after 10 years
1974-75	North Brevard	1,758,350	Dredging of Port Canaveral for Trident submarine base	Unknown
1980-81	Indiatlantic/ Melbourne Beach	412,830	Stockpiled Trident submarine base sediment	45 percent in place after 1 year
1985	Patrick Air Force Base	137,610	Stockpiled Trident submarine base sediment	No effect on long-term shoreline change rates
1986	City of Cocoa Beach	30,580	Scraped from intertidal zone, put on back beach	Unknown

Source: *Brevard County Comprehensive Plan* 1988; Sudar *et al.* 1995.

Storms and Hurricanes

Planning for the evacuation of coastal residents must include evacuation prior to the onset of gale-force winds (64 kilometers/hour or 40 miles/hour) and before flooding of the causeways occurs. The estimated time for evacuation of all residents in vulnerable zones is 18.5 hours (East Central Florida Regional Planning Council 1987). Table 10.2 shows the estimated evacuation population for Brevard County for 1995 and 2000. These estimates include evacuation of mobile home residents in the coastal zone because they are susceptible to high winds. Public shelter capacity is important for evacuation strategies. Shelters must be accessible in inland areas that are not vulnerable to storm effects. In Brevard County the primary shelters are at public schools, colleges, churches and recreation centers. The shelter capacity in 1986 was 37,905, which is calculated at 3.4 square meters (about 2.8 sq yds) per person, and it is estimated that 18.3 percent of evacuees will use public shelters (East Central Florida Regional Planning Council 1987). An additional 13 percent remain undecided and may use public shelters.

Table 10.2: Estimated Brevard County Evacuation Zone Population

Year	Residents	Mobile Home Occupants	Total
1995	142,448	31,751	174,199
2000	155,202	36,795	191,996

Source: East Central Florida Regional Planning Council 1987.

In Brevard County the most serious threats are from hurricanes. In 1979 Hurricane David threatened south Florida and traveled up the east coast of Florida causing massive evacuations. Damage in Brevard County was localized flooding and wind damage. More recently Hurricane Andrew was predicted to hit Satellite Beach in south Brevard County until the final hours before landfall. Hurricanes that form off the west coast of Africa typically reach the Caribbean and curve northwards. The northward tract prediction of Hurricane Andrew caused evacuations along the entire east coast of Florida, and activation of the Emergency Operations Centers in Brevard County. Hurricane Andrew never made the predicted turn to the north and hit south of Miami in August of 1992 sparing Brevard County of all but heavy rain and wind.

Coastal Construction Limitations in Brevard County

Brevard County has a complicated system of regulating construction in the coastal zone. The Coastal Construction Control Line (CCCL) was established in Brevard County in 1975, and is regulated by the Florida Statues, Chapter 163. It is administered by the Florida Department of Environmental Protection. The Brevard County Coastal Setback Line (CSL) was established in 1985 in response to the 1984 Thanksgiving Day storm. The 1984 Thanksgiving Day storm caused an average shoreline recession of 6.72 meters (22 ft) and an estimated average volumetric erosion of 0.2 cubic meters (0.26 cu yds) per year. An updated CCCL was established in 1985 (Brevard County Comprehensive Plan 1989).

The entire coastal zone in Brevard County is in the Coastal Building Zone. Standards for new construction for this zone, such as wind load and elevation specifications, are regulated by Florida Statues Chapter 161. In 1986, 47 single family and 50 multi-family structures were located seaward of the CCCL. Patrick Air Force Base is completely on the barrier island and has 3,100 residents. Community Facilities such as the Officers and Non Commissioner Officer's Club are located seaward of the CCCL. These facilities may be modified or repaired, only if it is not necessitated by erosion. Structures may not be expanded seaward. The Coastal Setback Line is inland of the CCCL. Structures that were constructed seaward of the County CSL, prior to its establishment, may be rebuilt if the assessed value of the structure is reduced by 50 percent. Rebuilding must meet all Coastal Building Zone specifications.

Coastal Barrier Resources Act Restricted Area

The Coastal Barrier Resources Act was established in 1982. The goals were to minimize loss of life and property, reduce emergency relief and flood insurance expenditures and prevent the destruction of ecosystems and wildlife. The area between Melbourne Beach and Sebastian Inlet has been designated an undeveloped barrier island. In this area, the following are not permitted:

- Federal Flood Insurance for structures that were constructed after 1982,
- public expenditures for infrastructure, such as bridges, water or sewer lines,
- beach stabilization projects.

Future Prospects

In 1985 the State of Florida mandated that Comprehensive Plans be adopted for all municipalities and counties in Florida. The Brevard County Comprehensive Plan contains a Coastal Zone Management Element. The projections of use of this coast increase from 7.8 million individual visits in 1995 to 9.5 million individual visits in 2000. Brevard County adopted goals, objectives, and policies to balance the demands of pressures on the coast. The primary goal for the coast of Brevard County is stated in the Brevard County Comprehensive Plan (1988);

> Establish growth management strategies that will allow growth to continue within the coastal zone, which does not damage or destroy the function of coastal resources, protects human life and limits public expenditure in areas subject to destruction by natural disasters.

It costs between $20 and $40 million to maintain Florida beaches each year (Finkl 1996). He has determined this is a mere 18 percent of total beach-related income, including direct sales and sales tax revenues that Florida receives, and the 359,000 jobs produced (Houston 1995). Finkl (1996) uses a 1994 Department of Commerce study to determine that 42 million tourists visit Florida annually and that 14 percent participate in beach-specific pastimes. Nationally Kirkpatrick (1996) estimates that the United States enjoys $1.3 trillion in beach-related tourism.

The human element is obviously a vital ingredient to the economic sustainability of Brevard County. Increased pressure on the coastal zone, however, will lead only to increased vulnerability. Although the coastal zone of Brevard county may appear highly urbanized and stable, it is important to remember that dynamic physical processes are operating on it. Physical processes can be augmented by activities such as renourishment, but in the long term sensible stewardship of the physical resources is vital. It is the only way to ensure that the coastal zone remains attractive to the industries and visitors that thrive there.

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11

Sinkholes in Florida

Robert Brinkmann

The study of landforms around the world leads geographers to a better understanding of the processes that shape our planet. Every part of the world has undergone a complex history of landscape formation. In some areas, such as in California, earthquakes dominate the landscape formation and cause millions of dollars worth of damage and considerable loss of life. Volcanoes also shape the landscape and can be locally and regionally devastating. Slower landscape formation processes, like the lapping of the waves on a shoreline or the slow advance of glaciers, are not as obvious as some of the more dramatic actions. These slower processes in time can dominate landscape formation.

Karst Processes

In central Florida, sinkhole formation is an example of a slow process that can dominate the landscape. Throughout the peninsula, sinkholes are found as lakes and dry depressions. Most of the sinkholes have formed in prehistoric time. Like the San Andreas Fault in California, sinkhole formation can be devastating. Thousands of dollars-worth of property are damaged by sinkholes every year in Florida and a number of deaths in the state have been attributed to sinkhole formation. Although not as dramatic as the San Andreas Fault, Florida sinkholes are fascinating natural hazards found throughout Florida and many other parts of the world.

Sinkholes typically are circular depressions that form in a type of terrain known as *karst landscape*. A karst landscape forms in areas underlain by soluble bedrock (Sweeting 1973). Usually the bedrock type is limestone, although karst landscapes can form in less widely distributed areas underlain by rocks such as halite, gypsum, and anhydrite (White 1988).

Limestone is a rock consisting mainly of calcite (calcium carbonate-$CaCO_3$) with some impurities of pyrite (FeS_2), quartz (SiO_2), gypsum ($CaSO_4.2H_2O$), dolomite [CaMg) ($CO_3)_2$], and other minerals. Limestone typically forms in shallow ocean or sea environments, although freshwater limestone is known to form in unusual circumstances.

Sometimes, limestone may form as a chemical precipitate as dissolved salt concentrations in the ocean reach a saturation point. A chemical precipitate is a solid that forms as ions combine within water. In this case, the ions are calcite and carbonate. The limestone produced through chemical precipitation is fine grained. Limestone, however, more typically forms as a result of biologic activity, and is of a type called biogenic limestone. Small shelled and non-shelled creatures live on or in the ocean-sediment interface at the sea floor. Many of these creatures excrete a fine calcium carbonate material that can lithify to become rock. Shelled creatures at death also contribute their exoskeletons to the sea floor and large concentrations of shells can lithify to form limestone. When limestone consists exclusively of shells, the rock is called coquina. Castillo San Marco, the historic fort at St. Augustine, Florida, was built with coquina. The unusual properties of the rock allowed it to absorb the massive energy carried with cannon balls that were sent from attacking ships. Other rock types would have shattered upon impact. The places where cannon balls hit the fort can still be seen as slight indentations on the coquina walls of the building.

Any form of limestone may dissolve to form a karst terrain. The solution of limestone proceeds through a regular reaction (Easterbrook 1993):

$$CaCO_3 + H_2O + CO_2 \rightarrow Ca^{++} + \text{-}2HCO_3.$$

In this reaction, water dissolves calcite in the presence of carbon dioxide to produce ionic calcium and the bicarbonate ion. The solution occurs in voids and cracks in the limestone where water can infiltrate. The solution effectively widens the cracks and expands the voids to cause the rock to be quite porous. In addition, water can dissolve the surface of the limestone (even a buried surface), thereby causing the thickness of the limestone to decrease.

The increase in the rock porosity weakens the limestone. In some cases, the pores interconnect and become conduits for water. Some of these are quite large and serve as subsurface rivers. When the underground voids weaken the limestone bedrock to the point that it can no longer support itself, the roof of the pore collapses. The physical collapse of the roof may occur slowly as bits of rock falling every now and again; or the collapse may be rapid and result in a catastrophic destruction of the void space.

The purpose of this paper is to review the major karst processes that occur in Florida and to describe one particular karst landform, the sinkhole, in detail from a geographic perspective. Particular attention will be paid to how and why sinkholes form and to the risk that sinkholes pose to the human environment.

Karst Landforms

Several landforms are created as a result of *karstification* (the process of karst weathering) including caves, sinkholes, solution valleys, springs, and cockpit karst. Discussion of each of these landforms will follow.

Caves

Caves are large voids in limestone that form as a result of intensive karstification. The void space expands when the cave is saturated. Once the caves drain, they begin to be destroyed because no water is present to cause solution of the limestone. The destruction process of caves starts with the formation of *secondary features*, such as stalagmites and stalactites, that develop *after* the formation of the void from dissolved minerals (including calcite) carried within water dripping into the cave. Stalactites and stalagmites occur as mineral-rich waters filter from the surface, through the soil, and into the cave. When the water drips from the roof of the cave, some of the dissolved minerals, mainly consisting of calcite, are left behind as a deposit. The minerals deposited from dripping water on the roof creates stalactites that hang *tight* to the ceiling and stalagmites on the floor and that *might* one day increase in size and reach the ceiling. When stalactites and stalagmites increase in size, they may connect and form a column. When water drips on the wall of the cave and deposits minerals, a flow stone forms.

Florida has a number of caves. Florida Caverns State Park in Marianna in the panhandle is perhaps the best known cave system in the state. Other, lesser known caves exist throughout all portions of the state (Brinkmann and Reeder 1994; 1995) and new caves are constantly being discovered. Divers, exploring caves that are actively forming, often find unique fossils and rock formations. Unfortunately, cave diving is very dangerous. One must be a certified cave diver before being able to dive in a cave. Even certified cave divers can run into trouble within a cave because it is very easy to become disoriented while diving within caves. The tight environment can also lead to claustrophobia and panic. If a diver panics or becomes disoriented, he or she can get lost and eventually run out of oxygen and die.

Although many of the caves in Florida are small, they serve as a unique habitat to a wide variety of animals. Many of the caves in the state have been badly vandalized and damaged. For this reason, many of the caves, unfortunately, have been blocked with bars to prevent human entrance, and the location of caves is a closely guarded secret among cave enthusiasts. Although most people who enter a cave do not intend to do damage, their very presence changes the chemistry of the cave atmosphere (which can then damage cave formations). In addition, people unwittingly damage caves by touching cave formations. A simple touch can change the surface chemistry of the formation to cause it to stop forming.

Springs

Springs are other features, typical of karst terrains, which occur in locations where groundwater reaches the surface from underground caverns. Often the groundwater has a significant discharge and produces what are known as spring runs. These are streams that start at the spring and that are fed almost exclusively by spring water. A number of streams in Florida are spring runs including the Crystal River.

Springs are openings into Florida's subsurface bedrock. Often this limestone subsurface is described as a sponge with interlacing conduit caves that transport huge amounts of water. Springs can be used to enter this sponge. In fact, cave divers enter the conduits through numerous springs throughout the state.

Springs are not only of interest to divers. Springs are noted for their clear, cool water and thus are attractions for those trying to seek refuge from Florida's hot summers. They are also known as places where manatees congregate. Homosassa Springs State Park is one location near Crystal River where manatees can be seen with some regularity.

Solution Valleys

Solution valleys are distinct valleys that do not form from the typical downcutting of surface streams. Instead, solution valleys form from the collapse of horizontal conduits (caves) in the bedrock. The resultant valley may or may not have an outflow. In some of the solution valleys, surface streams are not present. This type of solution valley retains only surface waters when the water table is at or near the surface. Solution valleys often have steep canyon-like valley walls and mildly convex valley profiles. Most of the predominant valleys that can be seen in Florida are solution valleys.

Sinkholes

Sinkholes are karst landforms that occur when rock failure or solution occurs at a point. The term *sinkhole* is used to identify closed depressions in the land surface that are formed by solution of near-surface limestone and similar rocks by subsidence or collapse of overlying surficial material into underlying solution cavities (Beck and Sinclair 1986). Topographically, sinkholes are usually identified by closed depressions in the land surface (Sinclair *et al.* 1985). Sinkholes are the most common karst features as well as one of the most easily recognized landforms on the earth's surface (Lane 1986).

All landscapes are affected in some way by weathering. The two major forms of weathering are chemical and physical. Chemical weathering occurs when rocks break down from chemical reaction. The chemical breakdown of limestone to produce void space is an example of this type of weathering. The type of chemical weathering that dissolves rock is called solution. Physical weathering is the physical breakdown or rocks. When a rock falls off of a mountain and breaks into a number of pieces upon impact at the base of the mountain, physical weathering occurs.

Sinkholes form from subsurface physical and chemical weathering by removing carbonate rocks (Newton 1987). Chemical weathering by solution is the predominant form of weathering. The removal of rock with continuing formation or enlargement of cavities can lead to the collapse of overlying rocks or sediments (physical weathering). The triggering mechanisms that cause sinkholes to form are large withdrawals of water, loading of land surface by construction of reservoirs and holding ponds, static loads (buildings), and vibratory and harmonic loads (e.g., trains, heavy equipment). It is no surprise that sinkholes commonly form beneath roads in Florida—often snarling commuter traffic. The state is also subjected to a spate of sinkhole occurrences after extremely heavy rainfalls that cause the ground to be saturated, heavy, and prone to collapse.

The term sinkhole is accepted throughout much of the world, although most karst scientists use the the term *doline*. Three major types of sinkholes are: solution doline, collapse doline, and the covered collapse doline (Figure 11.1). These sinkholes are represented on the landscape as closed depressions of various sizes. Sinkholes of different sizes and types occur throughout the state of Florida.

When sinkholes expand and coalesce, they often leave remnants of limestone, called towers, in a flat plain. This type of landscape is called cockpit karst. It is found in portions of the Caribbean (including Cuba and Jamaica), in China, and the Philippines. The dramatic landscape of cockpit karst derives from numerous towers surrounded by coalescing sinkholes or *cockpits*. Although Florida does not display the dramatic cockpit karst found in China, the landscape on the ridges is in an intermediate stage of developing into cockpit.

Collapse sinkholes form as a result of catastrophic failure of bedrock limestone above a void. The failure is usually sudden and results in a steep-sided circular depression filled with a jumble of broken limestone. These sinkholes usually form in well-drained limestone regions where void formation is advanced. Usually there is little surface sedimentation above the limestone. Interestingly, cave entrances may be found at the bottom of collapse sinkholes. The size of this type of sinkhole is controlled by the bearing strength of the limestone roof and the depth to the cavity. This sinkhole type is common in a coastal strip of west-central Florida in Pasco, Hernanado, and Citrus Counties.

Solution sinkholes form as limestone weathers from the surface down. The site of the surficial weathering is often dependent upon vertical cracks that focus surface water to the location for drainage. These sinkholes are subtle features on the landscape and form where limestone is thin or barely covered. Usually the water table is below the top of the limestone. The subsidence caused by this type of sinkhole is very slow and nearly imperceptible as the limestone at the surface dissolves. The sinkholes usually have gently sloping sides, and in some locations, are the sites for shallow ponds and wetlands. Because these sinkholes do not form from collapse, the sides and bottoms are underlain by continuous bedrock. With time, these sinkholes may fill with sediment. This type of sinkhole development produces the broad, shallow, funnel-shaped depressions found in the northern part of west-central Florida (Sinclair *et al.* 1985).

Cover collapse sinkholes form in areas where the limestone is overlain by some type of sediment. In many cases, the limestone is covered by sands, silts, or clays deposited during a period of geologically recent sea level highs. When the sea washed over the limestone, sediments were deposited on top of the limestone bedrock. When the seas retreated, the sediment remained as a cover. These sinkholes are often found at low elevations where seas have washed over the landscape at some point in the geologic past. Although other types of geologic situations can create an environment where limestone is covered by sediment (such as from landslides or alluvial deposits), most of the world's cover collapse sinkholes are found at low elevations near the coast.

Cover collapse sinkholes form from an initial collapse and from the sediment overlying the limestone filtering into the void within the limestone. The first stage of the development of the sinkhole is the collapse of the limestone into the void space which formed from the solution of the underlying portion of the limestone. When the collapse occurs, its expression may not be immediately evident form the surface. The sediment on top of the limestone may stay in place. Eventually, the sediment filters into the void space in similar fashion to sand filtering through an hour glass. After this happens, a depression forms at the surface that may be quite subtle. Cover collapse sinkholes often have a similar surface expression as solution sinkholes. On occasion, the collapse is large enough to cause the failure of not only the limestone, but also the sediment. When this occurs, the form of the sinkhole more closely resembles the steep-sided collapse sinkholes. The slow, filtering form of cover subsidence sinkhole is common in the cypress domes throughout Florida whereas the rapid collapse sinkholes are found throughout the central ridge portions of the state.

Sinkholes are distributed in specific regions of the United States where limestone and dolomite are present at or near the surface. These areas are common in selected locations in Appalachia, the Midwest, the Great Plains, portions of Texas, and the southeastern United States. Sinkhole formation proceeds most rapidly in warm humid areas and more slowly in dry cool regions. Therefore, sinkhole formation is most rapid in the humid subtropical regions of the United States. Florida, with its abundance of warm weather and precipitation, has the most dramatic regions of sinkholes in the country.

The sinkholes in Florida are mainly of the cover collapse variety. The reason for this is that most of the state consists of porous marine limestone covered with marine sand. These deposits create a unique stratigraphy in the state that influences the hydrology in the region (Figure 11.2). In much of Florida, the deep, productive fresh water aquifer is called the Floridan Aquifer system (Lane and Hoenstine 1991). The bedrock in this system consists of porous fossiliferous limestone mainly of Eocene age.

The saturated limestone is pockmarked with voids and caverns that allow a great storage of groundwater. Above the Floridan Aquifer system is the *Intermediate Confining Unit* (Figure 11.3). This layer serves as a barrier between the limestone and overlying marine sands. The confining unit contains a mixture of sands and clays that serve to impede water from filtering into the Floridan Aquifer System. In some places, often at sinkholes, this layer is missing or thin and water from the surface can enter the Floridan Aquifer System unimpeded. Above this confining unit are very well-sorted marine sands that make up what is called the Surficial Aquifer system. This sandy deposit may be saturated at depth, but is very permeable and allows water to flow through it easily.

This layer-cake hydrologic system throughout Florida is pock-marked with sinkholes. Nowhere is this more evident than in the central lake region of the Florida peninsula south to north from near Lake George through Orlando to near Sebring (Figure 11.4). In this area are hundreds of lakes and depressions that

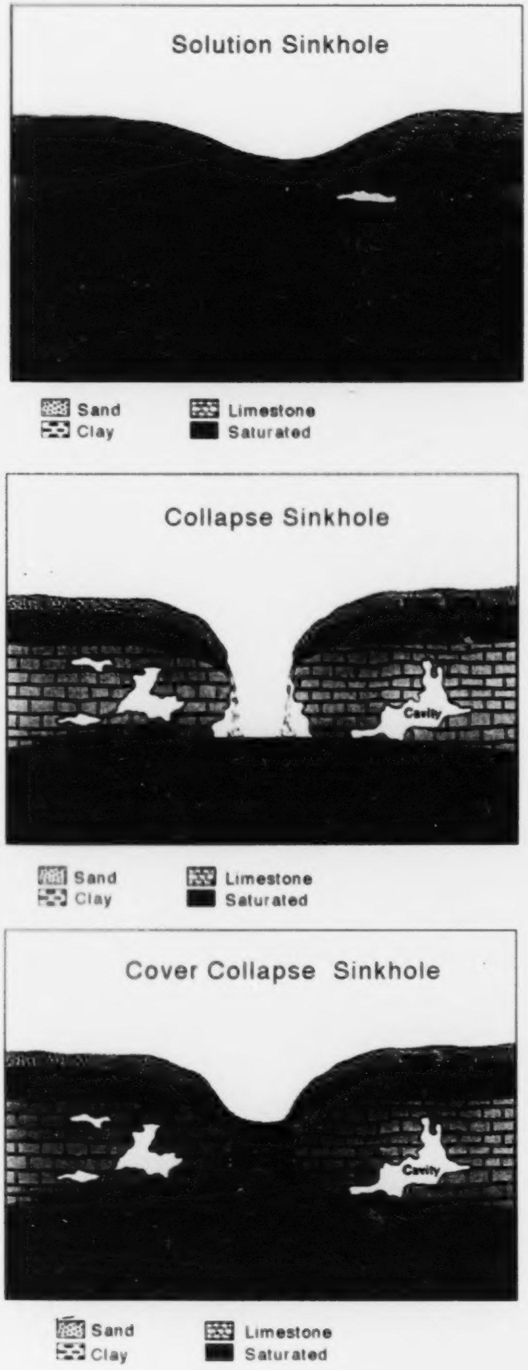

Figure 11.1: Three major types of sinkholes

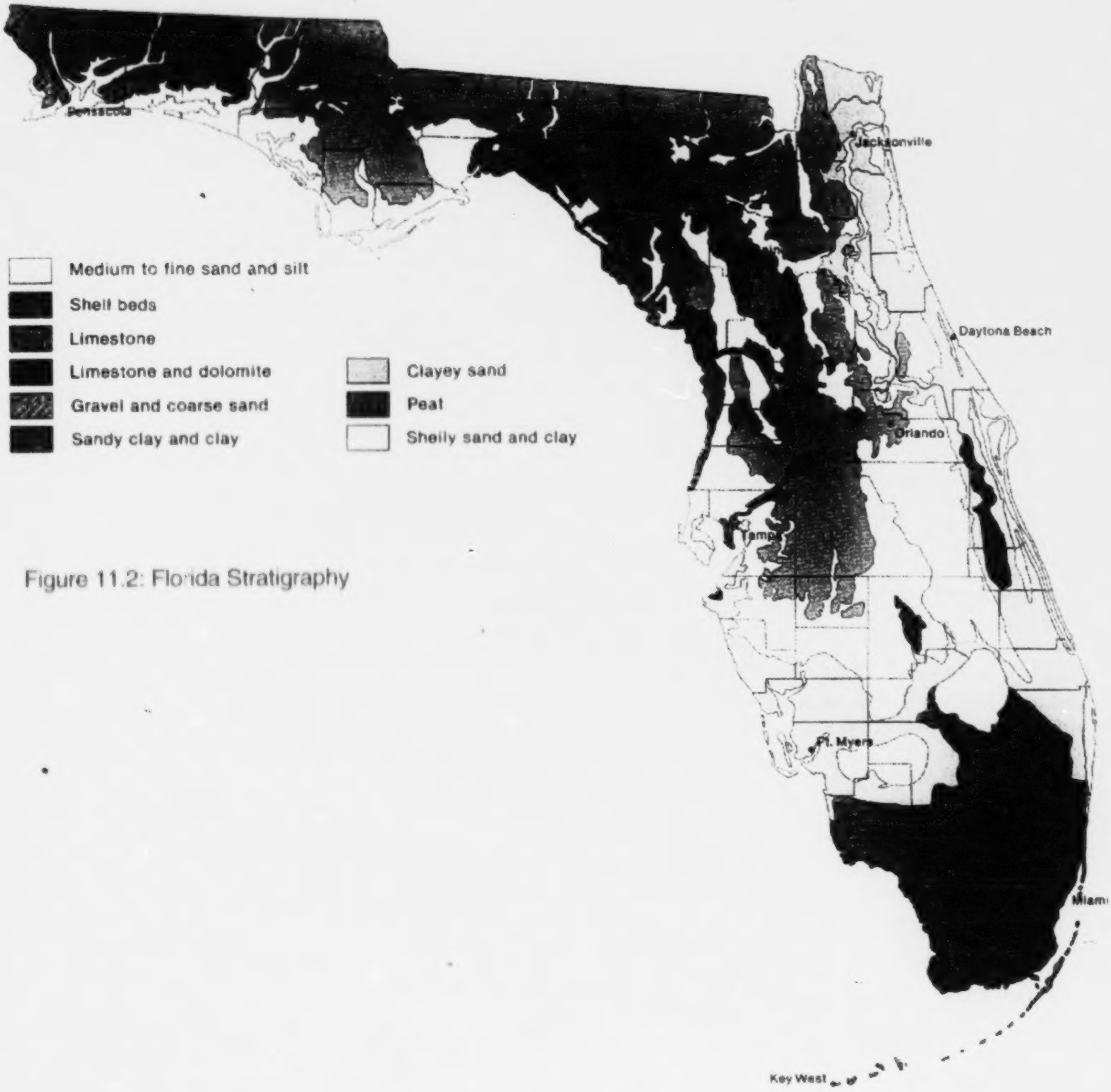

Figure 11.2: Florida Stratigraphy

formed from sinkholes. Some of these, such as Lake Apopka, are quite large. Others may be small and not easily discernible on maps or aerial photographs.

Sinkholes pose a serious threat to life and property in this area. It is common to hear of sinkhole damage on roads on drive-time radio. Municipalities deal with most of these problems by filling in the void with concrete followed by repaving. Of much greater significance is the damage done to homes through sinkhole collapse. Sinkholes collapse with little warning, so residents are unable to prevent damage when one occurs. Even small sinkholes may cause foundation damage that can force a home to be assessed as unsafe for habitation. When foundations crack and move, the entire house becomes unstable and uninhabitable. On occasion, very large sinkholes have caused severe damage.

Hydrostratigraphic Unit
Surficial Aquifer System
Intermediate Confining Unit
Floridan Aquifer System

Figure 11.3

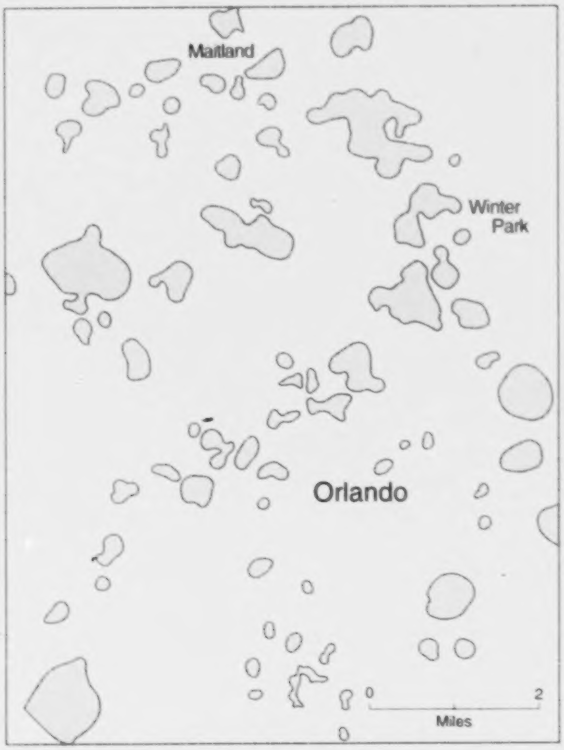

Figure 11.4: Distribution of Sinkhole and other Solution Lakes in the Orlando Area

One of the most dramatic sinkhole collapses in North America occurred in the community of Winter Park, located north or Orlando. Here, a large sinkhole opened from May 8-13, 1981 (Lane 1986) where it caused building and street collapse and ruptured water lines. In addition, a car dealership adjacent to the sinkhole suffered a significant loss of automobiles. Although this damage was dramatic, sinkholes every year cause thousands of dollars worth of damage to property around the sate.

Sometimes sinkholes cause death or injury. In 1968, the US 19 bridge over the Anclote River collapsed in Tarpon Springs, Florida, killing one person and injuring five others (Newton 1987). Certainly most sinkholes do not cause such terrible occurrences, but they are most definitely one of Florida's most severe, yet subtle, natural hazards. Sinkholes are also potential conduits for pollutants to aquifers. In 1963, as a result of a sinkhole collapse in Birmingham, Alabama, 40 million gallons per day of raw sewage entered streams for a three-month period. A sinkhole in the vicinity damaged the Birmingham sewage system causing the effluent to enter nearby streams (Newton 1987). Surface contaminants can also enter the groundwater via sinkholes. In the past, surface runoff in Florida was routed to sinkholes for flood control. This is no longer permitted because it pollutes the aquifer.

The disallowance of surface water drainage into sinkholes is a very sound public policy. Since Florida's aquifer system is like a sponge, one can envision a case where a truck hauling hazardous waste tips and spills its load. If this occurs, the load would drain into the designed water flow area along the roadway. In the past, sinkholes were often used to guide roadway drainage water. If the aforementioned hazardous waste spill occurred in the past, the waste would drain directly into the drinking water for the surrounding population. Now, drainage systems are designed to store water. Such storage areas, known as water retention ponds, keep storm water in a basin for days. The ponds are lined with clay that inhibits infiltration. The clay slowly allows the water to drain into the ground while filtering harmful chemicals out of the water. With modern drainage laws, many new developments contain storage ponds for their surface water. It is not uncommon to see water retention ponds associated with gasoline stations, housing developments, or grocery stores. Although these areas may not have hazardous waste spilled within the property lines, it is not unlikely that these areas may be subject to gasoline spills, pesticide spraying, herbicide spraying, or oil leaks. Any of these additions to the groundwater could greatly harm the aquifer system for a municipality or for an individual homeowner with a well. In either case, water retention ponds can solve many water contamination problems that are associated with karst terrains.

A number of economic costs are associated with sinkhole formation in urban areas (HUD 1979). The costs include:

- Structural damage, repair or replacement costs
- Depreciation of land value due to subsidence problems
- Replacement costs for personal property or livestock
- Dislocation expenses for business and private citizens during repairs
- Business income losses during dislocation
- Decreased economic growth because of a real or perceived hazard

HUD also believes that psychological costs are associated with sinkhole hazards. Stress, resulting from the considerable costs of continuous maintenance and stress related to the potential of losing one's home are common in areas with a sinkhole risk. The social costs of sinkhole hazards are difficult to assess. Areas where sinkholes have damaged property can become blighted as property values decline. A loss of community can occur when owners of affected property move away and can disrupt long-standing social conditions and patterns.

Conclusion

Karst terrains are among the most unique landscapes found on the planet. Common landforms associated with karst are caves, springs, and sinkholes. There are three major types of sinkholes: collapse, solutional, and cover collapse. The cover collapse sinkholes are the most common type found throughout Florida. The central lake district in peninsular Florida is one of the most dramatic sinkhole regions found in the world. Sinkholes cause thousands of dollars worth of damage every year in the state by collapsing beneath roads and buildings. Not only do sinkholes cause property damage, but they can cause death when catastrophic collapses occur. For this reason, sinkholes are considered one of Florida's most dangerous natural hazards.

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Lesson Plan: 12-A

What is a Boswash?

Kristin J. Alvarez

According to the first census of the United States in 1790, approximately 5 percent of the population of lived in urban areas. Today, roughly 80 percent of the population are urban dwellers. This rapid growth of cities, first fueled by the Industrial Revolution, has created in some areas, melding of adjacent cities. When large metropolitan areas reach out and touch each other's shoulders forming a long chorus line of kicking, strutting dancers, we have the modern phenomenon known as a *megalopolis*.

Level: Middle and Secondary Schools

Objectives:
(See sources on geographic skills and perspectives and standards at the end of this lesson.)
- to identify factors that influence location of cities
- to locate major urban areas of the world
- to identify activities associated with urban areas
- to recognize urban problems and propose possible solutions to those problems

Materials:
"U.S. at Night" poster; old U.S. or state road maps (1950s—check your library's vertical files); current U.S. or state road maps; overhead map of "Dreamland;" atlases.

Procedure:
Day 1:
1. Show "Dreamland" map on overhead. It is the year 1750. The entire class is setting sail for Dreamland, a very large island you have just discovered. The students' first task is to decide where to select sites for towns. Choose 6 to 7 students to place a dot where they would locate their town. (For an extra bit of fun, name these cities after the students who place them on the map.)
2. After students have selected all locations, ask them why they chose those sites. (There are no wrong answers.) Write the reasons for students' site selections on the chalk board (e.g., environment, transportation, defense, nearness to water)
3. Have the class use atlases to locate and report on examples of world cities and possible reasons for their locations (locational factors). (You can assign students to groups to examine and report on cities within a particular region or continent.)
4. Investigate and discuss possible reasons for the location of your community.
5. Discuss why and where new cities of the future might be located and how these reasons might be similar or different than those operating today (e.g., locations more remote from urban centers than today; locations in proximity to city locations today; underwater; outer space; Antarctica.) Collect comments on, e.g., problems of access, preparing urban infrastructures, advantages or disadvantages of certain sites.

Day 2:
1. Have students place numbers from 1-10 in a list on a piece of paper.
2. Explain that students will write the first thing that comes to their minds when given the name of a city (This is a word association exercise based upon their existing perceptions or knowledge of cities.). Read the following list of possible cities. You may use others with which they may be more familiar: New York, London, San Francisco, Paris, Chicago, Cairo, Tokyo, Detroit, Sydney, Miami.

3. Discuss answers and discuss different *personalities* of cities. Discuss how the personalities of these cities often reflect purposes (functions) and activities of cities (e.g., Washington, D.C.—a government center; New York City—financial center or port; Orlando—tourism or high tech industries; and Detroit—auto manufacturing). Stress that cities have more than one purpose of activity.
4. Categorize students' responses under broad headings of commerce, finance, industry, transportation, government, recreation, culture, and religion. Elicit examples from these and other headings, but stress that cities are not single-activity places.
5. Ask students to name professional sports teams in the U.S. and Canada whose names reflect a purpose or activity of their home city.

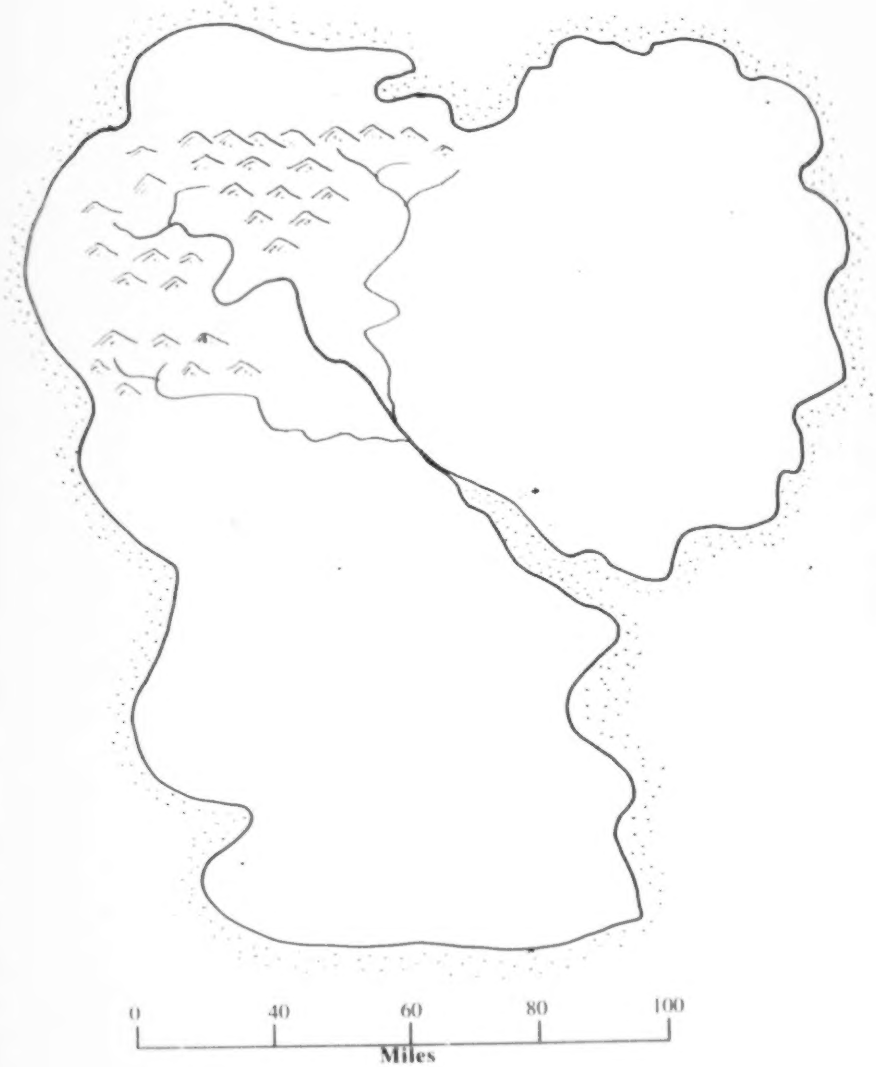
Day 3:
1. Divide the students into small groups of 3 or 4. Give half of the groups old (pre-interstate highway) road maps and ask them to map a trip between two assigned cities giving highway numbers, direction, and mileage. Give the other half of the groups modern highway maps according to the same directions given to the first groups. Have the matched groups compare their findings with the rest of the class.
2. Discuss the long-term effects of the Interstate Highway system, particularly on popular tourist destination areas. Introduce the highway numbering system (North-South—odd numbers; East-West—even numbers).
3. When discussing number of beltways, introduce concept of the *metropolis* by discussing its Greek origin (Why Greek?). Introduce the census term, *metropolitan area*. Introduce the term *suburb*. Discuss its Latin roots and discuss the history of the origins of the city of Rome on several hills and the small settlement at the bases of the hills (Why Latin?).
4. Show poster of "U.S. at Night" and have students identify major metropolitan areas. Discuss why they are located where they are.
5. Show list of words with no comment: Boswash (Boston, Massachusetts to Washington, D. C., Chipitts (Chicago, Illinois to Pittsburgh, Pennsylvania), Sansan (San Francisco, California to San Diego, California), and Jami (Jacksonville, Florida to Miami, Florida). Ask students to look at words and raise their hands when they figure out what they might mean. Prompt students to define megalopolis inductively. Have students locate these megalopolises on the "U.S. at Night" poster and the patterns they demonstrate as well as how they are similar or different.
6. Have students predict future growth of present megalopolises and where they think future megalopolises might appear. Have students find foreign megalopolises on world population maps in their atlases.

Extensions:
1. Have students investigate urban infrastructures and urban problems. Assign small groups to act as a city council with a budget to solve specific problems. The computer software, *Sim City*, is a wonderful resource for this type of activity.
2. Investigate (possibly on the Internet) the newly-planned Disney community of Celebration, Florida. Have students plan their own city from scratch. Discuss why they placed certain city functions in various parts of their city.
3. Locate several political cartoons about urban problems and hold class discussions on political cartoons about urban problems.
4. Create a futures scenario about the class's local community, describing the community 10, 25, to 100 years from now. Assign the different times to different groups and the compare and contrast the results.

References and Resources:

Geography For Life: National Geography Standards 1994. Washington D.C.: National Geographic Society. See especially pp. 49-55 for "Skills and Perspectives" and pp. 148, 167, 181, 188, 108, and 221 for "Standards." (Available from the National Council for Geographic Education, 16A Leonard Hall, Indiana University of Pennsylvania, Indiana, PA 15705, $7.00 plus postage and handling.)

DREAMLAND



Lesson 12-B

Surfing the Net to Investigate Florida's Vacation Destinations

Beth Kirk-Kent

Florida is one of the favorite travel destinations in the U. S. Main attractions include beaches and other activities that exist along the coastline. This lesson involves identifying some of Florida's coastal vacation spots and using the Internet to investigate what to see and do in these locations.

Levels: Middle and Secondary Schools

Objectives:
(See sources on geographic skills and perspectives and standards at the end of this lesson.)
- Identify some of Florida's major tourist destinations
- Identify some major attractions located in these locations
- Plan a fantasy trip around Florida

Procedures:
1. Choose at least 5 cities from a map of Florida showing a high amount of accommodations for visitors (e.g., hotels and motels)
2. Locate and label these cities on a blank map of Florida
3. Use the Internet (using various search engines) to locate information about these cities (e.g., attractions and activities, historical sites, accommodations, places to eat). Examples of various web site addresses and home pages are included at the end of this lesson.
4. Complete a worksheet filling in information about an imaginary trip around Florida.

Extensions:
1. Compile a more extensive list of web sites for Florida.
2. This lesson can be adapted for any other location. Have students investigate and compile a list of web site addresses for other places of interest in their state, our nation or other countries. You could catalogue these addresses into one reference source.

References

Geography for Life: National Geography Standards. 1994, Washington, D.C.: National Geographic Research and Exploration: See especially "Places and Regions," Human Systems," and "Environment and Society;" pp. 126-127, p. 129, p. 155, pp. 167-168. (Available from National Council for Geographic Education, 16A Leonard Hall, Indiana University of Pennsylvania, Indiana, PA, 15705, $7. 00 plus postage and handling.)

Map showing visitor accommodations. Fernald Edward A. and Elizabeth Purdum 1992. *Atlas of Florida*. Gainesville: University Press of Florida.

Various Internet Web Addresses for Information about Florida:
http://www.goflorida.com (Destination Florida)
http://www.goflorida.com/family/cities
http://www.abfla.com (Absolutely Florida Magazine)
http://www.abfla.com/1tocf/amusf/fun.html
http://www.City.Net/countries/united_states/florida

http://www.USAcitylink
http://www.sptimes. com (St. Petersburg Times)
http://www.herald. com (Miami Herald)
http://www.flatoday.com (Florida Today-newspaper for Brevard County (Space coast)
http://tboweb.com or tampatrib.com Ft. Lauderdale Sun-Sentinel)
http://www.times-union.com (Jacksonville Times-Union)
http://www.n-jcenter.com (News Journal of Daytona Beach

For lessons about Florida's History through its Places:
http://www.firn.edu/-fga/lessons.html#places

Florida Fantasy Vacation

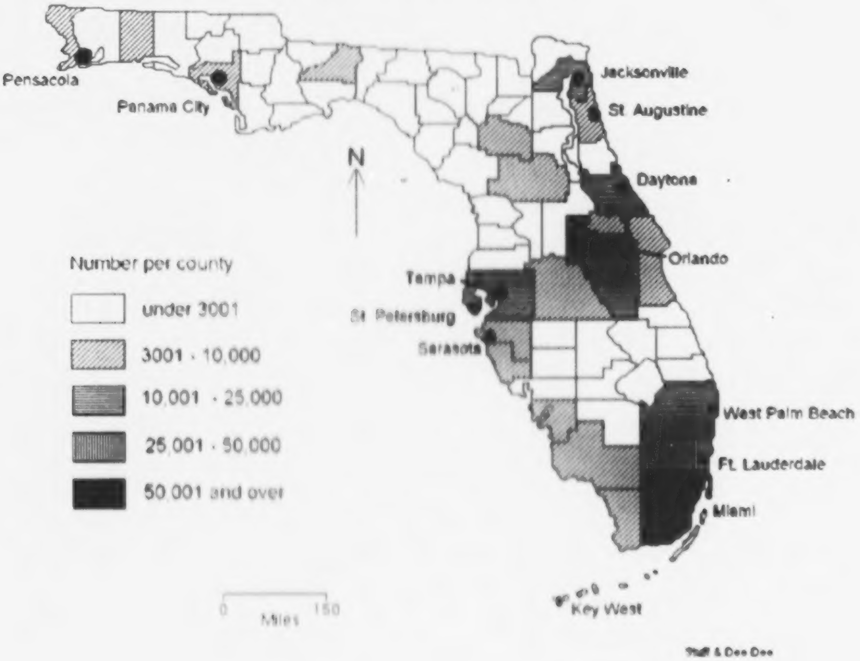
Directions:
Using the maps provided (visitor accommodations and map of Florida showing major cities), choose 5 cities you would like to visit. Choose cities that are at least 50-100 miles away from each other. Using the Internet, investigate your five cities for attractions or things to see and do, e.g., historical sites, places to stay. After completing your research, complete the following information sheets. Copy the form below for each city and number them 1 - 5.

Cities
1 - 5: ____
County: ____
Hotel/motel: ____
What will you do while in this city and the surrounding areas? ____________________
____
What upcoming events might you want to see (festivals, sports events, etc.)? ____________
____
____

- Now that you have completed your trip, please calculate the approximate mileage involved in your adventure around Florida:________miles

- Are there any interesting facts that you have learned about Florida while you were doing your research?______ If so, write a short paragraph about what you have learned.

Hotel and Motel Rooms, 1989



Lesson 12-C

More Than A Mouse

Ginny White

Although most people immediately associate Disney's Mickey Mouse with Florida, the state is much more than that. Life went on before Disney, beginning with from the Seminoles to the Spanish to settlers, both black and white. They left a literary heritage that reflected Florida's unique geography. By reading literary excerpts, students can experience the richness of Florida's historical geography.

Level: Middle School

Purpose:
Student understanding of Florida before Disney will be enriched by reading excerpts from Marjorie Kinnan Rawlings' *The Yearling*.

Objectives:
To develop a sense of place of pre-Disney central Florida and to examine themes in geography through Florida literature.
See especially:
Geography for Life: National Geography Standards 1994. Washington, D.C.: National Geographic Research and Exploration on behalf of the American Geographical Society (AGS), Association of American Geographers (AAG), National Council for Geographic Education (NCGE), and National Geographic Society (NGS): pp. 49-52, 69-74, 152-155, (Available from NCGE, Leonard 16A, Indiana University of Pennsylvania, Indiana, PA 15705-1087 for $7.00 per copy.)

Procedure:
1. Ask students to jot on a piece of notebook paper the first three thoughts they have when they think of Florida. List and tally the ideas they generate on the chalk board. See what percentage of the ideas involve Disney World. Discuss this perception and the other ideas they have about Florida. Are their perceptions related to tourism, physical features, Florida's history, famous people, etc.? What generalizations are possible from their perceptions?

2. If desired, the teacher or students may present some information they have investigated on Disney World. Good sources include *Atlas of Florida* and Disney World's web site especially a timeline on its development found at http://www.disney/com/Disney World/25th Anniversary/25th233.html

Background on Disney World from *Atlas of Florida* (Fernald and Purdum 1992): Walt Disney quietly purchased the 24,000 acre-(9,449 hectare-) tract near Orlando for Disney World in the 1960s at a cost of $5 million for approximately $180 an acre ($457 per hectare). Land values near the site soared to $80,000 an acre ($203,200 per hectare) when the news broke. The park opened in 1971; Disneyland in Los Angeles had opened in 1955. Disney chose the Orlando area for the following reasons: an inexpensive tract of land in a climate with warm winters, served by an interstate highway, and relatively close to large northern cities. The Florida legislature made the site even more attractive by giving Disney special governmental status over his property.

Tourist sites in Central Florida developed prior to Disney World include Silver Springs (1890), Cypress Gardens (1930), Weeki Wachee (1947), Busch Gardens (1959), and NASA Kennedy Space Center's Spaceport (1966).

3. Read Chapter 9 of Marjorie Kinnan Rawlings' *The Yearling*, which described how the Baxter family living in Florida's scrub country in 1870-1871 got their water from a sinkhole. Discuss what the students learn about the plants and animals, the Baxters' way of life compared to their contemporaries today. How are fundamental themes of geography (location, place, movement, human-environment interaction, and region) demonstrated in this chapter (Joint Committe 1984)?

Learning groups could be used both for reading and for producing a product related to the chapter: illustrations, a journal entry, illustrated charts of flora and fauna, research on sinkholes, a skit, the Baxter philosophy (e.g., "You kin tame anything, son, excusin' the human tongue."), creation of a Disney ride based on "old Floridy," reading about Marjorie Rawlings and her other works, and her life in Florida. *Cross Creek Cookery* as well as the movies, *The Yearling* and *Cross Creek* (about Marjorie's life in Florida) might also be useful.

Other chapters you could also use easily are Chapter 1, which describes Jody's taking in nature on a lazy April day, Chapter 10 in which Jody and Pa go fishing but he unexpectedly witnesses the dance of the whooping cranes, and Chapters 19 and 20, an historically-based account of a week-long storm, flood, and plague.

Extensions

Many other literary works are available to learn about Florida. A Florida Literary Map is available from The Florida Humanities Council, 1514 1/2 East Eighth Avenue, Tampa, FL 33605-3708.

The Talking Earth by Jean Craighead George (ISBN 0-06-440212-6) tells the story of Billie Wind, a Seminole living near the Everglades, who is grappling with her contemporary life and how it relates to Seminole legends and traditions. This is appropriate for upper elementary grade levels.

Eugenia Price wrote a trilogy on St. Augustine's history, *Don Juan McQueen Maria*, and *Margaret's Story* (This is adult literature but you might use excerpts from it).

Zora Neale Hurston's "My Birthplace" tells of Eatonville, a community near Orlando, that was the first Negro community in America to be incorporated. This chapter can be found in *Dust Track on a Road: An Autobiography* published by University of Illinois Press.

Many local libraries in Florida have collections of Florida stories and poetry, which are rich in presenting images of Florida. They appear in the references.

References

Fernald, Edward A., and Elizabeth D. Purdum, 1992. *Atlas of Florida*. Gainesville: University Press of Florida.

Joint Committee on Geographic Education, National Council for Geographic Education (NCGE) and the Association of American Geographers (AAG) 1984. *Guidelines for Geographic Education: Elementary and Secondary Schools*. Washington, D.C. and Macomb, Ill.: AAG and NCGE.

Jones, Jane Anderson, and Maurice O'Sullivan, eds. 1995. *Florida in Poetry*. Sarasota, Florida: Pineapple Press, Inc..

McCarthy, Kevin, ed. 1989. *Florida Stories*. Gainesville: University of Florida Press.

Miller, John and Kirsten, eds. 1993. *Florida Stories: Tales from the Tropics*. San Francisco: Chronicle Books.

Rawlings, Marjorie Kinnan 1942. *Cross Creek*. New York: Collier Books.

Rawlings, Marjorie Kinnan 1942. *Cross Creek Cookery*. New York: Charles Scribner's Sons.

Rawlings, Marjorie Kinnan 1939. *The Yearling*. New York: Charles Scribner's Sons. 1939. (Illustrations in the school edition of this book are by N. C. Wyeth, Andrew Wyeth's father.)

Lesson 12-D

Reading Landscapes

Lori A. Newman

If you were to question someone about their landscape they may comment on rolling hills, mountain ranges or bodies of water and other physical features that are surrounding them. Or, they may simplify such a question even further by commenting on how level their garden is or how well-drained the soil, or how the garden looks during rainy or dry seasons. What each of the people in these scenarios dismisses is the *cultural landscape* that humans have created.

Level: Middle and Secondary Levels

Purpose:
The purpose of this lesson is to help the students understand the meaning of cultural landscape, as well as to use the axioms of Pierce Lewis by *reading* it.

Time: Two class periods

Objectives:
At the conclusion of this lesson the student is able to*:

- Differentiate between physical and cultural landscapes.
- Apply the axioms in order to be able to "read" their local cultural landscapes.
- Compare their present local landscape with the landscape of the past.
- Identify the changes, and reason for these changes in their local cultural landscape.

**Geography for Life: National Geography Standards* 1994. Washington, D.C. : National Geographic Research and Exploration for the American Geographical Society, Association of American Geographers, National Council for Geographic Education, and the National Geographic Society. See especially pp. 150-155, 190-196, 49-56. (Available from the National Council for Geographic Education, 16A Leonard Hall, Indiana University of Pennsylvania, Indiana, PA 15705, $7.00 plus postage and handling.)

Materials:
Street map of your town or city, copies of handout #1, pictures of your town or city at different periods in history, promotional, and travel brochures (extension activity only)

Procedures:
Day 1
1. Introduce the concept of *cultural landscape* by questioning the students in order to determine what landscape means to them.

2. When it has become evident that everyone agrees that landscape has to do with some sort of physical feature, ask what they think *cultural landscape* might mean.

3. Try to guide students answers towards human-created landscape or built environment by giving them clues such as: homes, restaurants, hotels, and motels, signs, billboards, shopping plazas.

4. Distribute handout #1 and discuss the axioms they can use to study the landscape. As you proceed

through the list add examples of each that can be found in your city or town. For example, try to find examples of things that have been built by conquering geography (Axiom** of Environmental Control), as well as those built to preserve some type of history (The Historic Axiom). If you are located in a city can landscape or cultural disparities be found within your city limits (The Regional Corollary)?

Remember that not all of these axioms may apply to your area's landscape. Use only those that you feel are appropriate. If time allows, you might want to define each axiom in order to give your students a base which they could use to study other landscapes in the future.

***Axiom:* an established rule or principle, or a self-evident truth.(Webster)

5. Have students write a list of things they see on their way home that are part of the *cultural landscape*. Remind them that they can list anything that was constructed by humans and that they should use a keen eye to find some unusual things as well. Also, ask them to bring in any old photographs of their city or town that they may have available to them.

Day 2

1. Break class into groups of four to six students. Have them share their list with each other and see if they can fit them into one of the axioms that were discussed the preceding day.

2. Discuss the different routes the students take on their way home and highlight them on your street map. Divide the map into four quadrants, north, south, east and west of the school. Discuss some of the major activities that take place in each quadrant.

3. Review what the students observed on their way home. See if you can determine which direction they traveled by the things they have listed as part of the *cultural landscape*. Discuss how the activities of the area determine what humans have put there.

4. Compare old pictures of your city or town with what you would find in those locations today. Are the buildings still standing or have they been replaced by more modern ones? Is their function still the same (i.e., general store) or have they been replaced (i.e., supermarkets). If the city's or town's main economy has changed (i.e., farming to industrial), what events have caused such a change and how has this changed the *cultural landscapes?*

What changes in the "landscape" might we see in the next ten, twenty or even fifty years?

.Extensions:

1. Invite someone who has lived in your city or town their entire life to visit your classroom. Have him/her discuss with the class how the landscape has changed in their lifetime.

2. Invite a local geographer, historian, or architect to visit your class. Have them talk with the class about the period in which buildings in your area were built. Determine what else may have been constructed around this time based on design (The Corollary of Diffusion) or what might have been fashionable at the time (The Corollary of Taste).

3. Examine the promotional material and travel literature from your area. Determine if a tourist expectations would be met if their visit to the area was based solely on what they had read in a brochure (The Corollary of Nonacademic Literature).

4. If you live in a city that has different cultural regions have students examine shop signs as they travel around town. Do the names of places give clues as the cultural background of the area's residents? Is any of this culture reflected in the architecture of the buildings? (The Axiom of Cultural Unity and Landscape Equality)

5. If possible, obtain pictures of the landscape from different regions of the county. Compare how these landscapes differ from your area because of physical geographic features such as climate or topography, as well as different cultures (The Regional Corollary).

References

Lewis, Peirce F. 1979. "Axioms for Reading the Landscape: Some Guides to the American Scene." In *The Interpretation of Ordinary Landscapes*, ed. Donald W. Meinig. Oxford: Oxford University Press.

Reading Landscapes
(handout #1)

1. The axiom of landscape as a clue to culture

The corollary of cultural changes

The regional corollary

The corollary of convergence

The corollary of diffusion

The corollary of taste

2. The axiom of cultural unity and landscape equality

3. The axiom of common things

The corollary of nonacademic literature

4. The historic axiom

The corollary of historic lumpiness

The mechanical (or technological) corollary

5. The geographic (or ecological) axiom

6. The axiom of environmental control

7. The axiom of landscape obscurity

Lesson 12-E

From Rails to Planes

Nikki Born

Introduction:

The history of transportation systems in Florida does not follow the time line of these same systems in other parts of the eastern United States. The climate of Florida was considered too hot and wet for the kind of population growth that took place in the Westward Movement of the early and middle 1800s. In addition, the native population of Florida, which was made up of many American Indian tribes as well as escaped African-American slaves, made Florida a less than attractive place to live.

With the construction of the first railroads along the east coast of Florida, all of this changed. The agricultural industry now had the transportation network necessary to grow rapidly. The tourist industry also began to take off with many people from the northern cities coming to Florida for its warm winters.

Many of the early railroads and spurs that were built during this time period went through a period of decline. They became obsolete because of the development of the interstate highway system and airports in eastern and central Florida. Some of these old railroads were destroyed to make room for highways, but a few were converted into recreational and historical parks. Examples of this conversion are the St. Marks Railroad from Tallahassee to the Gulf of Mexico and the Parrish Rail that travels from Parrish, just north of Bradenton, to Tampa.

Level: Middle and High School

Standards: Refer to *Geography for Life: National Geography Standards* in References.

Objectives:

At the conclusion of this lesson on transportation in Florida, the student will be able to do the following:

1. Navigate through the *Florida Atlas* on CD-ROM on a computer.
2. Complete research on railroads in Florida using the Atlas and internet resources (if computer and CD are not available, you can use traditional research sources).
3. Locate and label railroads, interstate highways, and major airports on a map of Florida (these could also be done in an authoring program such as Hyperstudio or by stacking transparencies of Florida maps with each subject).
4. Complete biographical research about the early railroaders, i.e., Flagler, Plant.
5. Locate and label railroads converted into parks; list how these parks are used and explain the economic effects they have on the communities that border them.
6. Compare the location of railroads to highways and airports and describe the geographic connections of these locations.
7. Write a story if you were a traveler on an early railroad by describing the landscape, climate, and dangers encountered along the way.

Materials: computer, internet access, Florida map, colored pencils, *Florida Atlas* on CD-ROM

Procedures:

1. Read and discuss the introduction about transportation in Florida.
2. Set-up computer with *Florida Atlas* and modem.
3. Search the *Atlas* for transportation in Florida, history of transportation, railroads, highways, and airports, biographical information
4. Label blank Florida map with railroads, highways, and major airports. Use a different color for each system (alternative formats: Hyperstudio, transparencies).
5. Using research data, locate and label the railroads that have been converted into parks.
6. List and discuss the benefits or benefits these parks have had on the communities that exist around them.
7. Describe why the cities located near the railroads, highways, and airports developed where they did.
8. Write a story describing a trip on an early railroad.

Extensions:

Take a group of students on a field trip on one of the converted railroads. Have students write a story about what they see along the route. Tour a major airport and make a list of the businesses and highways located near the airports. Have a debate between Flagler and Plant concerning the advantages and disadvantages of developing Florida. Conduct a mock trial of either Flagler or Plant for the damage done to the environment of Florida with the construction of the railroads.

References:

Central Florida Museum Home Page

Florida Atlas on CD-ROM. See also reference on *Atlas of Florida* in the references in Lesson 12-C.

Geography for Life: National Geography Standards 1994. Washington, D.C.: National Geographic Research and Exploration for the American Geographical Society, Association of American Geographers, National Council for Geographic Education, and the National Geographic Society. See especially pp. 144-145, 184-185, 49-56. (Available from the National Council for Geographic Education, 16A Leonard Hall, Indiana University of Pennsylvania, Indiana, PA 15705, $7.00 plus postage and handling.)

Internet sources: Florida Geographic Alliance Home Page

Ivy, Russell 1997. "Transportation and Development in Florida: The Rise of Orlando in the Transport Hierarchy," Chapter 5 in this book.

St. Marks Railroad Home Page

Lesson 12-F

Resources and Tourism

Heather Wood

Theme: Environment and Society

Grade Level: 3-8

Overview:
Students will develop class definitions of resource types, investigate a Florida county, its resources, and tourism facilities. Students will classify the resources using class definitions. Students will then present their facts in the form of a mobile.

Materials:
Florida resource books (textbooks, atlases, almanacs), encyclopedias and tour guide books, wire hangers (2 per student), string, scissors, glue markers, magazine pictures to cut up (optional)

Time: Two lessons, 45 minutes each

Objectives:
By the end of the lesson, the student will be able to:

- complete individual research on resources and tourism.
- formulate class definitions of resources.
- classify resource types.
- creatively present their findings in the form of a mobile.

(*Geography for Life: National Geography Standards* 1994 listed under References at the end of this lesson.)

Procedure:

A-Initiating Activity: Students will formulate through class discussion definitions for renewable, nonrenewable, and perpetual resources. Students should copy all the final definitions for future use. Students will be assigned a county in Florida in which to conduct their investigations. Research should involve a number of resources so students are able to compare new and old data.

B-Strategies: Students will complete their research and classify their resources into the categories above. Also the research should include the tourism of their given county. After research is complete, students will create a mobile that includes their classifications, pictures, and facts. Two wire hangers should be used to form a crisscross pattern. Students can cut or draw pictures and use string to tie their findings to the hangers.

C-Culminating Activity: Students will present their mobile to the class and the teacher will ask questions to evaluate the quality of their research. The teacher will review terms at the end of the presentations.

Evaluation:
Teacher will grade the mobiles using a four-column rubric to check off the requirements. Each category: renewable, nonrenewable, and perpetual resources and tourism, should have about five entries. Pictures can come from any source, but they must include explanations of essential facts or ideas expressed.

Extensions:

1. Locate the findings on a base outline map of Florida. Then discuss generalizations about diffusion, density, patterns, and dispersions.
2. Students can take one resource and develop a research report on the resource and its effects of Florida's economy.

References

Geography for Life: National Geography Standards 1994. Washington, D.C.: National Geographic Research and Exploration for the American Geographical Society, Association of American Geographers, National Council for Geographic Education, and the National Geographic Society. See especially Grades K-4-Standards: 4, 3, 11, 14, 15, 16, 18.3 and skills and Grades 5-8 Standards 5.5, 7.3, 11, 16, 18.3 and skills. (Available from the National Council for Geographic Education, 16A Leonard Hall, Indiana University of Pennsylvania, Indiana, PA 15705, $7.00 plus postage and handling.)

Lesson 12-G

River Cities

Keith Tillford

Rivers played significant role in establishing settlements in the United States. Communities were often located along rivers in order to have a steady and abundant supply of water. As trade developed further, the rivers became increasingly more important as a means of transportation for goods and people. Location of cities on or near navigable rivers greatly affected their growth. People throughout the world have relied on rivers to enhance their lives.

Level: Middle School

Objectives: (See reference to *Geography for Life: National Geography Standards* 1994 at the end of this lesson.)
- To use a map or atlas to be able to identify cities located along rivers
- To determine the percentage of people within a state who live near its major rivers
- To compare the percentage of people residing near a major river in a landlocked state to the percentage of people living near a major river in a coastal state

Procedures:
1. Introduce the lesson by eliciting from the class what they know about rivers. Ask the students to name rivers in their state.
2. Distribute to each student an atlas that includes a map of their state. Assist the class in identifying the major rivers of the state. Adjust the number of rivers selected based upon the ability level of the class.
3. Instruct the students to list the names of the cities located near the major rivers. After students complete this, discuss the cities they identified.
4. Using either a table or an index with the population of the state's cities, have the students work in pairs to find the population of each city listed on their paper. Next, add the population numbers together.
5. Discuss with the class the procedure for finding the percentage of people residing along a major river within their state. Have the students determine the percentage.
6. Repeat procedures 1-5 using a different state. If the students live in a landlocked state, assign them to collect the data on a coastal state. If they live in a coastal state, then they should select a landlocked state for data collection. Exercise the option to require either all students to do the same state or you may allow a choice of states.
7. As a closing, instruct students to write statements comparing the percentage of the state's population living near the major rivers in the two states. Share and discuss the findings as a class.

Extensions:
- Have students collect the same data on a third-world country and the United States and compare the results.
- Use a U.S. map to identify federal parks and compare the number located around major rivers versus those located away from large rivers.
- Using a county map, find the number of local parks or other recreational facilities located adjacent to a river, stream, or lake. Discuss possible reasons for this. Have students investigate to determine if the local, state, or federal government owns the land. Brainstorm possible uses for this land.

Reference

Geography for Life: National Geography Standards 1994. Washington, D.C.: National Geographic Research and Exploration for the American Geographical Society, Association of American Geographers, National Council for Geographic Education, and the National Geographic Society. See especially Standards 2, 3, 4, pp. 146-151 and Skills, pp. 49-52. (Available from the National Council for Geographic Education, 16A Leonard Hall, Indiana University of Pennsylvania, Indiana, PA 15705, $7.00 plus postage and handling.)

Lesson 12-H

How to Develop Emeralda Marsh

Jim Curtis

Overview:
This lesson examines economic development by using three important economic concepts: threshold and range, and basic industry and its linkages, and opportunity cost. By understanding these concepts students will improve their understanding of their rapidly growing state and the various large-scale development projects that caused development and environmental conflicts.

For example, During World War II the idea of increased farm production outweighed environmental concerns in the Ocklawaha Basin, particularly at Lake Apopka. Lake Apopka is located in the southern part of the St. Johns Water Management District (northeastern part of the Florida Peninsula). Emeralda Marsh lies to the west of the lake, which is west of Orlando. Huge amounts of labor and capital were expended to turn marshy areas into farmland. Now, fifty years later, huge amounts of money are being expended to return that farmland to a more original ecosystem.

Subject Areas: language arts, social studies, science, vocational

Grade Levels: High School

Objectives:
(See reference to *Geography for Life: National Geography Standards* 1994 at the end of this lesson.)

- To understand the concepts threshold and range, basic industry and its linkages, and opportunity cost
- To identify typical high- and low-order goods and services
- To understand how a business brings rounds of economic activity both in that particular place and other places and how to show this with a flow chart
- To understand that economic decisions made for one place have both beneficial and detrimental effects

Class Time: 2-3 class periods

Student Materials: maps and drawing materials

Teacher Materials: overhead projector transparency masters

Suggested Procedure:
Explain and discuss the following economic concepts: Threshold and Range
Threshold: Distances necessary to provide a good or service
Range: Distance people are willing to go for a good or service

Threshold and range are economic concepts necessary to understanding how well an economic activity will perform in a particular place. Every economic activity needs to serve a number of customers to survive. The range for every economic activity varies according to how much people need or want that good or service. Goods and services that people are willing to travel only short distances to acquire are called low-order goods or services. Goods and services that people are willing to travel long distances to acquire are called high-order goods or services.

Have students give examples of low- and high-order goods and services.

Discuss where one expects to find low- and high-order goods and services.

Basic Industry and Its Linkages
A basic industry is an economic activity that produces a particular good, for example, an orange-juice plant. This activity requires many types of jobs that include management, industrial workers, and a support staff. Beyond this group of workers many other jobs are created. Jobs that provide goods and services necessary for the production of the basic industry are called backward linkages. These jobs would include the growers, pickers, and truck drivers. Jobs that are involved with the distribution of these goods are called forward linkages and would include truck drivers, warehouse workers, and salespeople.

A flow chart is a graphic description of a system or process. For our example a flow chart of the jobs associated with orange juice manufacturers would look like this:

Backward Linkage	Basic Industry	Forward Linkage
orange growers	management	truck drivers
pickers	industrial workers	warehouse workers
truck drivers	support staff	salespeople

Have students pick another industry and have them identify types of jobs in each sector.

Opportunity Cost
Human activity always changes the environment. Opportunity cost examines if the benefits outweigh the negative effects of an economic activity.

Begin Project:
Break students into groups of four or five students and give them a map of a section of Emeralda Marsh to develop. Have students brainstorm different economic activities for their areas.

Once they have established a list, have students determine which activities have the range to survive. Have them decide which activity they want to develop.

Have students determine jobs that will be created in the area by developing this activity. Have them categorize jobs (basic industry, forward, or backward linkage). Have them determine other jobs that are necessary to have in the immediate areas. Where do they fall in the categorization pattern? Have students construct a flow chart of basic industries and linkages.

Have students map the area they plan to develop.

Have students list beneficial and detrimental effects of this development and determine opportunity costs. What arguments can be made for or against their development?

Have students develop and give a presentation for the class.

Evaluation Tool and Assessment

Flow chart:
Have students identify jobs associated with a particular economic activity and determine whether they have they successfully developed categories that are integral to the basic industry as well as forward linkage or backward linkages.

Presentation: Use the following rubric for student presentations.

25 percent: presentation skills (A/V use, vocal quality, etc.)

25 percent: shows they have considered range and threshold for this economic activity.

25 percent: shows that they have identified basic industry jobs and jobs associated with backward and forward linkages.

25 percent: shows that they have tried to assess the opportunity costs for this economic activity.

Explorations And Extensions:

Have students find newspaper articles detailing: How a new industry is going to affect the economy of an area. How a past economic activity has affected an area. Different developmental strategies for both rural and urban areas

Reference

Geography for Life: National Geography Standards 1994. Washington, D.C.: National Geographic Research and Exploration for the American Geographical Society, Association of American Geographers, National Council for Geographic Education, and the National Geographic Society. See especially Standard 11, pp. pp. 206-207 and Skills pp. 53-56. (Available from the National Council for Geographic Education, 16A Leonard Hall, Indiana University of Pennsylvania, Indiana, PA 15705, $7.00 plus postage and handling.)

Lesson 12-I

Land Use in Hillsborough County, Florida*

Heather Wood

Overview:
*This activity can be adapted to any topographic quadrangle of Florida. Students will use aerial photo maps or United States Geological Survey (USGS) quadrangles to develop land use maps of the studied area. Students will make presentations to the class and cartographic discussions will follow.

Grade level: 5-12

Theme: environment and society, the world in spatial terms

Materials:
USGS topographic map quadrangles or aerial photo maps, large tracing paper or transparencies, colored pencils, markers, pencils, transparency pens

Time: 2-3 lessons, 45 minutes each

Objectives:
- By the end of the lesson, the student will be able to:
- analyze aerial photo maps and or USGS topographic maps.
- create generalized land use maps.
- present findings to the class orally.
- work cooperatively in groups. (See reference to *Geography for Life* at the end of this lesson.)

Procedures:

A-Initiating Activity: Students will need lesson on basic cartographic techniques and map requirements. Students will then look at the aerial photographs or topographic maps and group discussion will follow about land use. This works well if you discuss the aerial maps view first, allowing for hypothesizing from the photo. Next, compare the topographic map with the aerial photo.

B-Strategies-: Students working in small groups of three, will create a generalized land use map of their quadrangle. Prior discussion will center around examples of these kinds of maps. Students can create maps of their entire quadrangle using large tracing paper or sections of their quadrangles using transparencies.

C-Culminating Activity: Students will present their map to the class. Discussion will follow about the use of symbols and how to generalize with maps. Also discuss the distribution and patterns of development.

Evaluation: participation in class discussion. Creation and presentation of group land use map.

Extensions:
1. Create land form map and make comparisons to the land use maps.
Physical versus Human Systems
2. Use stereoscope pairs and stereoscopes to see their area in three dimensions.
3. Compare the history of land use in your area with topographic maps from the past.
4. Discuss or investigate how different groups of people can lie using these maps. Try it out on your class! (See Monmonier 1991.)

5. Look at soils survey books and compare land uses or land forms to soil types.

References

Geography for Life: National Geography Standards 1994. Washington, D.C.: National Geographic Research and Exploration for the American Geographical Society, Association of American Geographers, National Council for Geographic Education, and the National Geographic Society. See especially Grades 5-8: pp. 144-155, 158-159, 164-166, 169-182 Grades 9-12: pp. 184-189, 201-202, 206-209, 212-222; Skills: pp. 49-56. (Available from the National Council for Geographic Education, 16A Leonard Hall, Indiana University of Pennsylvania, Indiana, PA 15705, $7.00 plus postage and handling.)

Monmonier, Mark 1991. *How to Lie with Maps*. Chicago: University of Chicago Press.

Adapted from Dr. Bruce Bradford, Stetson University, De Land, Florida.

Lesson 12-J

Shifting Sands

Debbie Hagenbuch-Reese

Introduction:
Sand dunes perform a valuable service to beach areas by providing protection from erosion. When a dune system is destroyed by construction the natural protection from waves and storms is lost.

Dunes only form along beaches where long-shore currents can move vast amounts of sand along the coast. Wind also plays a vital role by moving the sand after it has been deposited and then cause it to mound. Unless vegetation can stabilize dunes they will continue to drift, perhaps joining with a larger existing mound. The following activity will demonstrate to students parts of the process of dune formation.

Grade Level: 5-8

Purpose:
To demonstrate the formation of sand dunes along some coastal areas.

Objectives:
(See reference to *Geography for Life* at the end of this lesson for appropriate standards and skills.)
1. Students will observe and describe the movement of sand in dune information.
2. Students will observe and describe how natural vegetation causes dunes to become stabilized.

Materials:
One cardboard shoe box, scissors, clean, dry sand, small bits of sand with weeds and grass implanted, one drinking straw, newspaper

Procedure:
Place newspaper on the table or desk. Cut out the end of the shoe box and place it on the paper. Form a small dune you have just made with the sand. Blow a stream of air from the straw toward the sand. Be sure to keep your mouth level with the bottom of the box and move the straw from side to side to distribute the breeze evenly. Take notes about the movement of the sand. Keep the breeze blowing until the dune has moved about 5 cm (about 2 inches). What happens to the sand on the windward side? How does this compare with the leeward side?

After completing the procedure repeat it with the following variation. This time include bits of rooted vegetation in the dune. (If the appropriate vegetation does not exist in your school yard you may want to plant some grass seed a few weeks in advance to allow the roots to hold.) How does the shifting of the sand in the second dune compare with the first? Take notes and compare with the first observation.

*Adapted from "Dunes On The Move." *EcoVentures TM Learning in Florida's Environment* 1995. Tallahassee: Florida State University.

Reference

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